NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400

ISY

Debbie Rivera
Headquarters, Washington, D.C.
(Phone: 202/358-1743)

For Release
April 1, 1993

EDITOR'S NOTE: N93-014

CULTURAL DIVERSITY IN NASA SUBJECT OF SPEECH

NASA Administrator Daniel S. Goldin will discuss NASA's goals for achieving a work force representative of America's cultural diversity at the National Association for Equal Opportunity in Higher Education (NAFEO) Conference, Friday, April 2, at the Washington Hilton, Washington, D.C.

Goldin will be the featured luncheon speaker at NAFEO's 18th annual conference. His speech will begin at 1:30 p.m. EST.

- end -

NASA News

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For Release

Mark Hess
Headquarters, Washington, D.C.
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April 1, 1993

Editors Note: N93-15

O'CONNOR TO MEET WITH PRESS ON APRIL 5

Bryan O'Connor, Deputy Director of the Space Station Redesign Team, will be available to meet with media representatives at 1 p.m. EDT, Monday, April 5.

The meeting will take place in the OSF-2 Conference Room, 7D61 in the NASA Headquarters Building, 300 E. St., S.W., Washington, D.C. The conference room is on the east end of the 7th floor of the Headquarters Building. Signs will be posted to guide you to the conference room.

O'Connor will provide a status briefing of the Station Redesign Team activities to date and answer media questions. The meeting will not be carried on NASA Select television.

-end-

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Donald L. Savage
Headquarters, Washington, D.C.
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For Release
April 1, 1993

EDITOR'S NOTE: N93-016

NASA FY 1994 BUDGET BRIEFING SCHEDULED FOR APRIL 8

The briefing on NASA's fiscal year 1994 budget request is scheduled for 11:00 a.m. EDT, April 8. The briefing will be held in the NASA Headquarters auditorium, main floor lobby level, 300 E. Street, S.W., Washington, D.C.

Participants will include NASA Administrator Daniel S. Goldin and Acting Comptroller Gary B. Allison. A summary of the budget request will be distributed at the beginning of the briefing.

The briefing will be carried live on NASA Select television (Satcom F2R, transponder 13, frequency 3960 MHz, 72 degrees west longitude).

- end -

NASA News

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Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/358-0883)

For Release

April 1, 1993

Diane Farrar
Ames Research Center, Mountain View, Calif.
(Phone: 415/604-3934)

RELEASE: 93-58

DIAMONDS IN THE SKY CHALLENGE GALAXY EVOLUTION THEORIES

Findings by scientists at NASA Ames Research Center, Mountain View, Calif., challenge the theories of how galaxies evolve.

Scientists observed huge amounts of microscopic diamonds in star-forming clouds in the Milky Way galaxy. This discovery contrasts with the prevalence of softer hydrocarbons they observed in the thin space between clouds. The observations of these two independent and very different types of interstellar hydrocarbon dust suggest that the materials are not mixing as generally assumed.

Astronomers have believed that materials flow freely between the dense clouds that coalesce into stars, planets and comets and the more tenuous regions between them.

"We thought that the dust and chemicals in spiral galaxies -- rotating pinwheels of stars -- mixed freely over relatively short astronomical periods," said Lou Allamandola, head of the science observation team.

"We were looking at star-forming clouds expecting to find simpler forms of hydrocarbons, molecules that make up materials similar to candle wax or gasoline. These molecules more easily form in the conditions of space," he said.

"Instead of finding the expected simpler hydrocarbon molecules we found large quantities -- the equivalent of planetary masses -- of micro diamonds dominating every star-forming cloud we look at. This shoots a hole in a major premise of galactic chemical evolution theories," science team member Scott Sandford said.

- more -

Saturated Hydrocarbons Missing

"The surprise is that in the dense clouds, the waxy, saturated hydrocarbons are not there. Because of the slowly spinning spiral arms of the galaxy, we assumed they would be mixing," Allamandola said.

Billions of tons of micro diamonds were discovered last year in dense star-forming clouds by this team. Like physicians using dye to track fluids in a human body, the astronomers used micro diamonds and other solid interstellar materials to track the movement and evolution of matter in space.

"The current theory is that star-forming clouds form by gravitational forces in space. As their masses increase, so do the gravitational forces. Eventually stars ignite in the densest regions in galaxies.

"The pressure from the light in new stars pushes outward, breaking up the remains of the clouds and pushing all the left-over material from the clouds out into space. Then the cycle starts again," Sandford said.

"The carbon crystals of micro diamonds are good tracers because they're tough enough to stand getting kicked in and out of a star-forming cloud. You would expect to see them in both dense clouds and in the near-empty space between them," he said.

"You would expect to find other materials such as ice crystals only in one environment. Ice crystals are present in dense clouds but don't survive in the diffuse regions between them because of heat and searing radiation. Once formed in the dusty, cold clouds, the ices are cooled and protected," said XanderTielens, another team member.

"Apparently the shorter chains of saturated hydrocarbons do not survive the transit into dense clouds. This means that we don't understand how matter moves in and out of these clouds. This means that our models of galaxy evolution are flawed," Sandford said.

The Allamandola team puzzled unsuccessfully for more than an year before originally identifying abundant microscopic diamonds in star-forming clouds. Having observed a prevalence of softer hydrocarbons surviving in the harsher regions between the clouds, they expected these or similar materials to be common in the dense clouds as well.

"In retrospect, our discovery of microscopic diamonds should not have come as a surprise, because they previously have been found in several types of primitive meteorites," Allamandola said.

Micro Diamonds Widespread

The team's findings also eliminated specific sources for the diamond flecks found in meteorites. Their observations from Hawaii's Mauna Kea infrared telescope found micro diamonds to be widespread and very abundant, comprising 10 to 20 percent of all interstellar carbon.

This suggests that uncommon star types or relatively rare supernova are not uniquely responsible for their formation.

"Our observations support the theory that meteoritic diamonds form in many regions of space, either in carbon star atmospheres or as the result of carbon grains colliding at high speeds in interstellar space," Allamandola said.

Their results are published in the current issue of Science magazine. The authors include Drs. Allamandola, Sandford and Tielens, Ames Research Center, and Dr. T.M. Herbst, Max Planck Institute, Heidelberg, Germany.

This research is supported by the Space Science Division at Ames Research Center and the Office of Space Science, NASA Headquarters, Washington, D.C.

- end -

NASA News

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For Release

Jeff Vincent
Headquarters, Washington, D.C.
(Phone: 202/358-1898)

April 1, 1993

RELEASE: 93-59

SPACE STATION REDESIGN ADVISORY MEMBERS NAMED

Along with Dr. Charles M. Vest, recently named by Vice President Albert Gore to head the Advisory Committee on the Redesign of the Space Station, NASA has announced the names of representatives from government and industry and academic experts from across the country to participate in an independent review of the redesign options being developed by NASA.

"I am extremely honored to have been selected to lead this important review panel. America's future in science and technology and as a world leader in space demands our utmost attention and care," said Vest. "We have assembled a diverse panel of experts that, I believe, will bring the appropriate measures of insight, integrity and objectivity to this critical task."

The Advisory Committee is charged with independently assessing various redesign options of the space station presented by NASA's redesign team, and proposing recommendations to improve efficiency and effectiveness of the space station program. Space station international partners also are being asked to participate and will be named at a later date. The Advisory Committee will submit its recommendations in June.

Advisory committee members named today include:

- more -

Dr. Bobby Alford
Exec. Vice President & Dean of Medicine
Baylor College of Medicine

Mr. Jay Chabrow
President
JMR Associates

Dr. Paul Chu
Director, Texas Center for Superconductivity
University of Houston

Dr. Ed Crawley
Professor of Aeronautics & Astronautics
Massachusetts Institute of Technology

Dr. John Fabian
President & CEO
ANSER

Maj. Gen. James Fain
Deputy Chief of Staff for Requirements
Headquarters USAF Materials Command

Dr. Edward Fort
Chancellor
North Carolina A&T State University

Dr. Mary Good
Senior Vice President of Technology
Allied Signal, Inc.

Mr. Frederick Hauck
President
International Technical Underwriters

Dr. Lou Lanzerotti
Chairman, Space Sciences Board
National Research Council

Mr. William Lilly
National Academy of Public Administration

Mr. Duane McRuer
President
Systems Technology, Inc.

Dr. Brad Parkinson
Prof. of Astronautics and Aeronautics
Stanford University

Dr. Robert Seamans
Former Deputy Administrator
NASA

Dr. Lee Silver
W. M. Keck Foundation Professor for Resource Geology

California Institute of Technology

Dr. Albert "Bud" Wheelon
Retired CEO
Hughes Aircraft

- end -

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ISY

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

For Release
April 2, 1993

EDITORS NOTE: N93-17

STS-56 NASA NEWSROOM HOURS AND PROCEDURES

During Shuttle mission STS-56, the NASA newsrooms supporting the flight will have extended hours of operation. However, staffing and budget constraints will force some NASA newsrooms to be closed in the evenings and on weekends.

To permit media questions in daily mission press briefings, the following procedures are to be used when a newsroom is closed and it is not possible for the media to ask questions directly of press conference briefers.

Media should write down their name, affiliation and question(s) and facsimile the question(s) to the newsroom at the NASA center originating the briefing at least 1/2 hour prior to the start of the news conference. Facsimile numbers are listed in this release. The question(s) will be given to the appropriate briefer who will read the question over NASA Select TV and answer it or refer it to the appropriate expert. Newsroom personnel WILL NOT forward verbal questions to the briefing participants.

In an effort to facilitate the flow of communications, listed below are the times each newsroom will be open along with contact phone numbers.

STS-56 NEWSROOM OPERATIONS
(Based on 4/6/93 launch)

Kennedy Space Center, Fla.

Operating Hours	
L-2	7:00 a.m. - 4:30 p.m. Eastern
L-1	7:00 a.m. to
Launch day	6:00 p.m. Eastern
On-Orbit (weekdays)	7:00 a.m. - 6:00 p.m. Eastern
On-Orbit (weekends)	Closed
Landing day	Landing - 4 hours to Landing + 4 hours Eastern

Phone Numbers

Newsroom:	407/867-2468
Facsimile:	407/867-2692
Code-A-Phone:	407/867-2525

After Hours:
Dick Young - 904/423-1800
Bruce Buckingham - 407/728-7545

Johnson Space Center, Houston

Operating Hours	
L-2	Closed
L-1	8:00 a.m. - 5:00 p.m. Central
Launch day	7:30 p.m. (4/5/93) - 5:00 p.m. Central
On-Orbit (weekdays)	12:00 a.m. - 5:00 p.m. Central
On-Orbit (weekends)	12:00 a.m. - 5:00 p.m. Central
Landing day	12:00 a.m. - 5:00 p.m. Central

Phone Numbers	
Newsroom:	713/483-5111
Facsimile:	713/483-2000
Code-A-Phone:	713/483-8600

After Hours:	
Jeff Carr	713/474-3166
Barbara Schwartz	713/474-4769

Marshall Space Flight Center, Huntsville, Ala.

Operating Hours	
L-2	Closed
L-1	8:00 a.m. - 5:00 p.m. Central
Launch day	11:30 p.m. (4/5/93) - 6:00 p.m. Central
On-Orbit (weekdays)	6:00 a.m. - 6:00 p.m. Central
On-Orbit (weekends)	6:00 a.m. - 6:00 p.m. Central
Landing day	6:00 a.m. - 5:00 p.m. Central

Phone Numbers	
Newsroom:	205/544-6381
Facsimile:	205/544-2819
Code-A-Phone:	205/544-6397

After Hours:
Dom Amatore - 205/461-7833
Mike Simmons - 205/882-1882

Dryden Flight Research Facility, Edwards, Calif.

Operating Hours	
L-2	Closed
L-1	7:30 a.m. - 4:00 p.m. Pacific
Launch day	Not open for launch / 7:30 a.m. - 4:00 p.m. Pacific
On-Orbit (weekdays)	7:30 a.m. - 4:00 p.m. Pacific
On-Orbit (weekends)	Closed
Landing day	Landing - 2 hours to Landing + 4 hours Pacific

Phone Numbers	
Newsroom:	805/258-3449
Facsimile:	805/258-3566
Code-A-Phone:	805/258-2564

After Hours:
Nancy Lovato - 805/948-2957
Don Haley - 805/943-5817

- end -

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For Release

Dwayne C. Brown
Headquarters, Washington, D.C.
(Phone: 202/358-0547)

April 2, 1993

Fred A. Brown
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-7277)

RELEASE: 93-60

NASA TDRSS NETWORK MARKS 10 YEARS OF OPERATION

April marks the 10th anniversary of NASA's Tracking and Data Relay Satellite System (TDRSS), a revolutionary, space-based network developed to meet telecommunications needs essential to the success of Space Shuttle, space station and other low Earth-orbiting spacecraft missions.

The TDRSS replaced a nearly 25-year-old, world-wide, ground-based tracking and communications network. That system only allowed spacecraft to communicate with Earth when in sight of a ground station. The TDRSS, initiated following studies in the early 1970's, was seen as a means of halting the spiralling costs of upgrading and operating ground stations as NASA telecommunications requirements grew.

"In essence, TDRSS allows NASA to do more with less. Communications operating costs were cut by as much as 60 percent while the system actually increases NASA capabilities to work in space," said Charles Force, Associate Administrator for Space Communications, NASA Headquarters, Washington, D.C.

TDRSS began with the launch of the first satellite on April 4, 1983. Since then, four other satellites have been put into orbit, the latest in January of this year. This communications capability in orbit and the one remaining spacecraft nearing completion for a future Space Shuttle launch should carry NASA's communications capabilities into the later part of this decade.

The TDRSS is equipped to support up to 24 user spacecraft, including the Space Shuttle, simultaneously. It neither processes nor alters communications, rather it functions as a repeater. At its highest capacity, the TDRSS can transfer in a second the equivalent of a 20-volume encyclopedia containing over 34 million words.

- more -

The TDRSS consists of two elements: a constellation of geosynchronous satellites and a ground terminal located in White Sands, N.M. Because of their high geosynchronous orbit 22,300 miles (35,800 km) above the equator, the TDRSS has increased data acquisition and communications with spacecraft from 15 to 85 percent of each Earth orbit and in some cases 100 percent depending on a spacecraft's orbit position.

The TDRSS enables uninterrupted, real-time communications -- a vital function monitoring astronaut life support and other systems during Shuttle and space station operations.

"The TDRSS supports nearly all of NASA's Earth orbital spacecraft. The Gamma Ray Observatory, the Cosmic Background Explorer, the Hubble Space Telescope and many other missions all were designed with TDRSS in mind," said Charles Vanek, TDRSS Project Manager at the Goddard Space Flight Center (GSFC), Greenbelt, Md.

The TDRSS also can provide multiple access relaying data from as many as 20 low-data-rate (100 bits per second to 50 kilobits per second) user satellites simultaneously and single access which will provide two high data rate channels to 300 megabits per second from both the East and West satellite locations.

Among future TDRSS dependent missions are the space station and the Earth Observing System. It is estimated that over $70 billion in space missions throughout the end of the decade will be TDRSS dependent.

Each TDRS is a three-axis stabilized satellite weighing about 5,000 pounds (2,540 kg) -- one of the largest, heaviest and most complicated satellites ever launched into geosynchronous orbit. The satellite measures 57 feet (17.4 meters) across the solar panels.

TRW Space & Electronics Group, Redondo Beach, Calif., is the prime TDRSS spacecraft contractor. Ground operations are conducted by GTE Government Systems, Corp., Needham Heights, Mass., and Bendix Field Engineering Corp., Columbia, Md. NASA's GSFC manages the daily operation of the system. The Office of Space Communications, Washington, D.C., has overall management responsibility.

- end -

NASA News

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Debra J. Rahn
Headquarters, Washington, D.C.
(Phone: 202/358-1639)

For Release

April 2, 1993

RELEASE: 93-61

PRIME AND BACKUP COSMONAUTS NAMED FOR SHUTTLE STS-60 MISSION

NASA and the Russian Space Agency (RSA) today announced the selection of Sergei K. Krikalev as the prime mission specialist and Vladimir G. Titov as the backup mission specialist on the STS-60 mission currently scheduled for launch in November 1993.

The two cosmonauts have been undergoing mission specialist training for at NASA's Johnson Space Center, Houston, since early November 1992.

Charles F. Bolden, Jr. (Col., USMC) is the STS-60 Commander. The other U.S. crewmembers are Pilot Kenneth S. Reightler, Jr. (Capt., USN), and mission specialists Franklin R. Chang-Diaz, Ph.D., N. Jan Davis, Ph.D., and Ronald M. Sega, Ph.D.

Mission objectives include a number of microgravity experiments in Spacehab-2, the Wake Shield Facility experiment to test the creation of an ultra-vacuum to produce extremely pure thin film crystals for industrial uses ranging from microelectronics to lasers and superconductivity, a Capillary Pumped Loop Experiment to study a method of heat dissipation in space and a number of small experiments known as Getaway Specialists flown in the orbiter's payload bay. Russian Space Agency-sponsored life science activities also will be included in the mission.

The flight of a cosmonaut on the STS-60 mission is one element of the Implementing Agreement on NASA/RSA Cooperation in Human Space Flight, signed by NASA and RSA on October 5, 1992. Other elements include the launch of a NASA astronaut to the Russian space station Mir in March 1995 and the U.S. Space Shuttle/Mir docking in June 1995.

- end -

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For Release

Debra J. Rahn
Headquarters, Washington, D.C.
(Phone: 202/358-1639)

April 2, 1993

RELEASE: 93-62

NASA AND THE RUSSIAN SPACE AGENCY SIGN MARS '94 CONTRACT

NASA Administrator Daniel S. Goldin and Russian Space Agency (RSA) Director Yuri Koptev today announced that they have signed a contract with a potential value of $1.5 Million to fly two U.S. Mars Oxident Experiment (MOX) instruments on the Russian Mars '94 Mission.

The Mars '94 Mission, to be launched in November 1994, will deploy small landing stations and penetrators and carry a complement of instruments to study the surface and atmosphere of the planet Mars.

Under the contract, the Babakin Engineering Research Center, Moscow, and the Space Research Institute of the Russian Academy of Sciences, Moscow, will provide technical services for integrating and testing the U.S. MOX instruments.

A duplicate MOX instrument will fly on each of the two Russian small stations. These instruments will conduct soil reactivity/composition experiments to provide chemical information about the volatile components in the martian soil. These experiments will enable scientists to characterize the martian physical and chemical surface environment.

Subject to appropriation of funds in FY 94, NASA plans to exercise an option under the contract to procure an engineering model of the Mars '94 small station. This will allow NASA to perform integration tests with the U.S.- supplied flight instrument systems in preparation for integration on the flight models with minimal impact to existing instrumentation. The model also will improve NASA's understanding of lander technology for future mars missions.

The implementing agreement on NASA's participation in the Russian Mars '94 Mission was signed by NASA and RSA on October 5, 1992, in Moscow.

- end -

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For Release

April 6, 1993

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Michael Finneran
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RELEASE: 93-63

SCIENTISTS REVEAL NATURE OF EXPLODING, RED SUPERGIANT STAR

NASA scientists have direct evidence that red supergiants -- the largest stars known -- end their existence in massive explosions known as supernovae. Until this week, astronomers could only speculate that these explosions represented the death of such stars.

"It's a very exciting result and a tremendous advance for stellar astronomy," said Dr. George Sonneborn, of NASA's Goddard Space Flight Center, Greenbelt, Md.

"This substantiates decades of work in stellar structure theory," said Sonneborn, a research scientist for NASA's International Ultraviolet Explorer (IUE) satellite, which obtained the new evidence through observations of a new supernova on March 30. "It has long been suspected that red supergiants explode to become supernovae. Now we have first-hand evidence of that."

"This clearly is the second most important supernova of the century," said Sonneborn. "It's of major significance."

The Type II supernova took place about 12 million light-years from Earth in a galaxy known as M81 in the Ursa Major or Big Bear constellation. It has been designated SN 1993J because it was the tenth supernova discovered this year.

IUE's Fast Response Was Critical

The supernova's nearness and the quickness with which IUE was able to observe it were critical factors that enabled scientists to verify an aspect of stellar evolution theory.

- more -

A supergiant is massive -- about the diameter of the solar system out to the planet Jupiter. Stellar evolution theory long has taught that red supergiants can explode to become supernovae. But in the only previous case in which astronomers definitively determined the type of star that produced a supernova explosion, it turned out to be a smaller and hotter blue supergiant. That supernova occurred in 1987, 160,000 light-years away and also was observed by IUE.

The difference between red and blue supergiants is that the blue variety are believed to have evolved from red supergiants after shedding much of their extended atmosphere. Thus, blue supergiants are smaller than red supergiants.

The satellite's observations of the supernova revealed that the exploding star is surrounded by a thick shell of slowly expanding gas. Heated to very high temperatures by the enormous energy released in the stellar explosion, the ultraviolet emissions from this glowing gas were detected by IUE.

A red supergiant loses large amounts of material through a slowly moving wind flowing outward from the star. The presence of this glowing gas in the first observations of the supernova means that it must be close to the explosion and that the star must have been in a red supergiant phase shortly before its demise.

In a Type II supernova explosion, the central core of the supergiant star collapses after the star uses up its nuclear fuel. This central implosion sets off an explosion of the outer layers of the star, leaving behind a small, incredibly dense remnant body called a neutron star or possibly a black hole. A black hole derives its name from the theory that its gravity is so powerful not even light can escape it.

"A supernova is the most cataclysmic event in the universe," said Goddard's Dr. Yoji Kondo, IUE Project Scientist. "The light it produces for a few weeks is roughly equivalent to the brightness of the whole Milky Way galaxy, which contains a few hundred billion stars."

Explosions of these huge stars are not uncommon, but rarely are they observed so close by, Kondo added. "On a cosmic scale, it's practically a next-door neighbor," he said, of SN 1993J which IUE observed after it was first spotted by amateur astronomers in Spain.

Prior to the 1987 blue supergiant explosion, the most recent nearby supernova that could be seen without a telescope took place in 1604 and was observed by Johannes Kepler, one of the great German astronomers.

Unlike the 1604 and 1987 supernovae, however, the one viewed March 30 was not close enough to be visible to the naked eye. Its brightness was of 9.2 magnitude. A brightness of at least the sixth magnitude would have been necessary for the March 30 supernova to be seen without using a telescope.

Learning From SN 1993J

Kondo and Sonneborn said much stands to be learned from the March 30 supernova. Because it is so close and because IUE observed it so quickly, scientists will obtain data about the explosion that they otherwise would not have gotten.

"We'll learn things about supernovae that we never could have until now," said Sonneborn.

For instance, astronomers for the first time anticipate studying the stellar wind -- the outflowing of energy -- from this type of star in a fashion not possible before. That's because the light from the supernova illuminated the red supergiant's stellar wind in a way that scientists can see it, Sonneborn said.

"The stellar wind will tell us about the late stages of the star's life prior to the explosion," Sonneborn said. "This also is a rare opportunity to study the tenuous gases in the far reaches of the Milky Way galaxy and in the M81 galaxy by observing the absorption caused by such gases upon the spectrum of this bright supernova."

NASA's International Ultraviolet Explorer was launched into modified synchronous Earth orbit in January 1978 by a Delta rocket from Cape Canaveral, Fla., in cooperation with the European Space Agency (ESA) and the British Science and Engineering Research Council. It is managed by Goddard Space Flight Center for the Office of Space Science at NASA Headquarters in Washington, D.C. Goddard shares operational control of the satellite with the ESA in Villafranca, Spain.

- end -

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For Release

Sarah Keegan
Headquarters, Washington, D.C.
(Phone: 202/358-1902)

April 6, 1993

RELEASE: 93-64

GIBBONS OUTLINES SPACE STATION REDESIGN GUIDANCE

Dr. John H. Gibbons, Director, Office of Science and Technology Policy, outlined to the members-designate of the Advisory Committee on the Redesign of the Space Station on April 3, three budget options as guidance to the committee in their deliberations on the redesign of the space station.

A low option of $5 billion, a mid-range option of $7 billion and a high option of $9 billion will be considered by the committee. Each option would cover the total expenditures for space station from fiscal year 1994 through 1998 and would include funds for development, operations, utilization, Shuttle integration, facilities, research operations support, transition cost and also must include adequate program reserves to insure program implementation within the available funds.

Over the next 5 years, $4 billion is reserved within the NASA budget for the President's new technology investment. As a result, station options above $7 billion must be accompanied by offsetting reductions in the rest of the NASA budget. For example, a space station option of $9 billion would require $2 billion in offsets from the NASA budget over the next 5 years.

Gibbons presented the information at an organizational session of the advisory committee. Generally, the members-designate focused upon administrative topics and used the session to get acquainted. They also received a legal and ethics briefing and an orientation on the process the Station Redesign Team is following to develop options for the advisory committee to consider.

Gibbons also announced that the United States and its international partners -- the Europeans, Japanese and Canadians -- have decided, after consultation, to give "full consideration" to use of Russian assets in the course of the space station redesign process.

- more -

To that end, the Russians will be asked to participate in the redesign effort on an as-needed consulting basis, so that the redesign team can make use of their expertise in assessing the capabilities of MIR and the possible use of MIR and other Russian capabilities and systems. The U.S. and international partners hope to benefit from the expertise of the Russian participants in assessing Russian systems and technology. The overall goal of the redesign effort is to develop options for reducing station costs while preserving key research and exploration capabilities. Careful integration of Russian assets could be a key factor in achieving that goal.

Gibbons reiterated that, "President Clinton is committed to the redesigned space station and to making every effort to preserve the science, the technology and the jobs that the space station program represents. However, he also is committed to a space station that is well managed and one that does not consume the national resources which should be used to invest in the future of this industry and this nation."

NASA Administrator Daniel S. Goldin said the Russian participation will be accomplished through the East-West Space Science Center at the University of Maryland under the leadership of Roald Sagdeev.

- end -

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For Release

Jim McCulla
Headquarters, Washington, D.C.
(Phone: 202/358-0002)

April 8, 1993

EDITOR'S NOTE: N93-19

NASA CHIEF OUTLINES MOVES TOWARD CULTURAL DIVERSITY

Attached is the text of an address by NASA Administrator Daniel S. Goldin, outlining recent actions to emphasize cultural diversity within the organization. The speech was delivered April 2 at the annual conference in Washington of the National Association for Equal Opportunity in Higher Education.

In this address, the NASA Administrator:

o Announces a plan to double support of Historically Black Colleges and Universities. In 1992, NASA increased support to these schools by 11 percent to almost $24.8 million, including an increase of 64 percent in student assistance funding.

o States that the agency has set a goal of awarding at least 8 percent of its contracts to small and disadvantaged and women-owned businesses by 1994. The award level to these businesses in fiscal 1992 was 7.2 percent, exceeding a goal of 6.75 percent. NASA awarded $13.4 billion in new contracts in fiscal 1992.

o Notes that the agency has established a $310 million set-aside for high tech work by small and disadvantaged firms.

o Announces that the agency will sponsor 27 conferences for small and disadvantaged businesses in 22 cities this year.

o Outlines agency incentives and other inducements to the space industry to exceed small and disadvantaged business subcontracting goals.

In the bulk of the talk, Goldin emphasizes how the exploration of space can serve as a catalyst for hope and achievement in minority communities.

- end -

Remarks Prepared for Delivery:

Cultural Diversity and the Evolution of NASA

Daniel S. Goldin
Administrator
National Aeronautics and Space Administration

National Association for Equal Opportunity in Higher Education (NAFEO)

18th Annual Conference
Washington, D.C.
April 2, 1993

Cultural Diversity and the Evolution of NASA

Remarks by
DANIEL S. GOLDIN
Administrator
National Aeronautics and Space Administration

Good afternoon, ladies and gentlemen, and thank you very much for asking me to come speak with you here today. I have come to talk about some of the goals and challenges we have set for ourselves at NASA, and to offer a few challenges of my own for all of you.

One of the challenges we all face is the long reach of human ignorance. Galileo Galilee, the great Italian scientist of the 17th Century, faced ignorance and arrogance in his life. More than 380 years ago, after his landmark discovery of four moons circling Jupiter, an astronomer named Francisco Sizzi wrote, "Jupiter's moons are invisible to the naked eye and therefore can have no in fluence on the Earth, and therefore would be useless, and therefore do not exist."

What a thought process! But as seekers of knowledge and truth, we humans have almost always been up against a great wall of ignorance. We don't know what we don't know. Many of the greatest discoveries and technological breakthroughs have been blind stumbles in the dark. The genius of many of those advances, however, was that people had faith in themselves and a profound willingness to learn, despite the unknowns.

I work at a pretty special place. The NASA I have come to know in the year I have been the Administrator is an exciting, relatively youthful federal agency where it is still O.K. to dare to dream, and where we are well aware that we have our own level of ignorance about the sea of space all around us.

Right now we can view the Earth from space, but we understand precious little about what mechanisms drive our environment. We don't know whether the increase in atmospheric carbon dioxide we have measured will be absorbed by the oceans. We don't know if there was ever a seasonal hole of any size in the ozone layer over the Antarctic before we had a satellite up there to measure it.

We know there is life on Earth, but we don't know whether it ever developed on Mars. And just a few months ago, before plunging into the dense Venusian atmosphere and burning up, the Pioneer Venus probe gave us new evidence that there may once have been oceans on Venus. Did life once form there? We don't even know if there is life on planets outside our solar system, or even if there are other planets beyond the nine we know of. So far, we have only informed speculation and indirect evidence to support that the ory.

So in this world in which computers and television overwhelm us with wave after wave of information, true knowledge about our place in the cosmos is as elusive as ever. But every day, we roll back the boundaries of our ignorance just a little more.

Not long after I was confirmed as the NASA Administrator last year, some events crystallized my deep conviction that NASA owes a special debt to the nation. Because of our position and visibility, we have to do more to make sure that the face of NASA reflects the face of America. Let me tell you what happened.

I had been in this job for just a few weeks. At the time, we were just a few days away from launching the Space Shuttle Endeavour for the first time. This is the Shuttle that was built to replace the Challenger, and there was a great deal of attention, not to mention a great many hopes and dreams, riding on that mission. At the same time, I had been contacted by Tom Paine, who asked to see me. Tom was a former NASA Administrator, one of the titans of the early years of the space program, and he was on his death bed. I was scheduled to leave Washington in the afternoon and fly to Los Angeles to see him. We got a call late in the day telling us the aircraft couldn't leave because LAX was closed.

I had no idea what was going on. I used to work in Los Angeles. It is the city where my children grew up, and where they still live. So I called my wife and asked her what was happening. She told me about the civil unrest in South Central L.A., and as I later watched the terrible hopelessness and the frustration that played across the television, it made me very sad. Had the Endeavour launched just a few days earlier, the fires of Los Angeles would have been visible to our Shuttle astronauts from space, a glow of despair from far below. And that imagery would have passed through the unique window that NASA provides to the world.

How terrible that the same sort of ignorance about the physical universe that the astronomer showed toward Galileo's discovery can also be manifested, in a much broader sense, in the ignorance with which we interact with one another. There is a high level of ignorance, in 1993, of the need all people have for self-esteem, and of the need all people have to be able to dream. We cannot afford to ignore either one.

The unrest in Los Angeles served to deepen my strong conviction that we have to do something to fight the ignorance that chips away relentlessly at human dignity and self worth. We have to do something about dislocation and hopelessness and the lack of equal opportunity in this country. We have to give our children, all children, the ability to dream.

It simply isn't enough to say that you don't believe in discrimination or inequality. You have to do more. What happened in L.A. was the result of a lack of hope, a lack of opportunity. What chance does a young person have, what hope can a girl or a boy muster if their parents are out of work -- if they have no opportunity for meaningful work, if they see no role models around them to help lift them up and give them a sense that they can accomplish anything they can dare to dream? We can help provide that hope.

NASA is an agency with proud traditions and an incredible past full of great accomplishments. In just 35 years of existence, NASA has sent humans to the Moon, charted all but one of the planets in the Solar System, developed the world's first true space ship, and helped to usher in the digital revolution we all take for granted every day when we watch our solid state TVs, listen to our compact discs, cook in our microwaves or call a friend on our cellular telephones.

Because of this proud past, because of NASA's high level of visibility as an icon of American achievement and the possibilities of high-tech, the agency also has a special responsibility to the nation, a responsibility to inspire, to offer hope, to be relevant to America and to serve as a beacon to our children.

And it is because of that special responsibility that we feel a need to reach out, to broaden our own levels of cultural diversity and offer opportunity to people of all backgrounds, all colors, all cultures and all walks of life. If you go back and look at newsreel footage from the Mission Control Center during the Apollo era, you will see that virtually everyone in the room, during the epic triumph of landing on the Moon, was a white male. A great many people of color across our country in the late 1960s felt dislocated from that triumphant moment.

Today, if you visit Mission Control during a space shuttle flight, you will see some Black women or Hispanic males or people of Asian, Indian or Middle Eastern descent. The number of culturally diverse faces is growing. We are proud of that diversity, but it's still not enough. We have to do more.

Simply put, we have accepted President Clinton's challenge to help reinvent government, to make our programs more cost effective and more relevant to peoples' daily lives. The U.S. space program belongs to each and every one of you, to all Americans, and our triumphs are diminished if they do not touch and inspire a cross section of the nation.

I grew up in the South Bronx during the 1940s and 1950s. In those days, the classrooms I sat in were filled with children who represented a broad mix of races and nationalities. Despite our differences in appearance or cultural backgrounds, it was a wonderful experience because we learned about each other. And we learned together.

Today this might be considered an ideal multicultural environment, a true rainbow classroom. Back then, of course, no one had ever heard of multiculturalism or ethnic diversity, and to me it just seemed normal. It was the only world I knew. Only later, as an adult, did I learn that it was not the typical experience of most Americans my age.

I believe NASA should be the epitome of that same kind of multiculturalism. We have to help make government and public service meaningful to our people. To do that, to contribute to the future of our children and their children, we have to concentrate on four things.

First, NASA has to provide inspiration. We have to continue to give inspiration to the Black child in Queens or Detroit or South Central Los Angeles, who looks up one day and sees that she has a role model, an astronaut and physician by the name of Mae Jemison, who became the first woman of color to fly in space. We have to provide inspiration to farm boys and boys in the 'hood alike, to give them intellectual nourishment, to let them know that there are opportunities out there, and that they too can join in this great adventure.

I've been to inner city schools, where they know who NASA's African-American astronauts are. The pictures of Charlie Bolden and Fred Gregory and Ron McNair are all over the place. All people dream, all people wonder, all people look to a horizon and wonder what lies beyond. NASA has to be a catalyst for that wonderment. We have to provide the inspiration that lets people dare to achieve.

Second, we have to provide hope. We have to hope that our children will have a better life than we had. We have to push our technology, our knowledge and our understanding of the forces that drive the environment of this planet to make sure that our children will have a healthy environment to live in. We have to think about the future, think about the fact that there are 5.5 billion people on this planet today, and remember that by 2025, that number is expected to double. We have to consider the limitless sources of energy and raw materials that await us in space, and work for the day when we can go there, as a matter of course, and retrieve those riches for the benefit of all people back here on the Earth.

Third, NASA must provide opportunity. And that opportunity must exist on several levels. We must provide opportunities for those youngsters from every background and every walk of life, to learn, to grow, and to have a chance to sit in Mission Control or to ride on a Shuttle or study airplanes in wind tunnels or work on satellites that will study the ecosystem of the Earth. But on another level, we must continue to push the boundaries of the known, and pay back the nation's investment in space exploration by creating and transferring new technologies into the private sector. We must use that to create jobs and new high-tech opportunities for women and people of color and the disabled to become entrepreneurs, physicists, chemists and researchers.

A fourth worthy goal for a world-class space agency must be to use the lure of discovery to promote peaceful partnerships -- partnerships between nations, partnerships between the government and academia, partnerships between historically black colleges and universities and small, disadvantaged businesses, between students, teachers and entrepreneurs.

Those are our goals, but I want to tell you this is more than talk. NASA is doing something about this commitment right now, today.

I have, for example, asked all of NASA's senior managers, both in Washington and at the field centers, to sign up to a goal on contracting with minority and women-owned businesses, and I have further asked them to specify what percentage of those contracts will be for high-technology work. The objective is to bring a broad mix of our nation's people into daily contact with the aeronautics and space programs of this agency. We will not be satisfied if the jobs we create are limited to washing windows and scrubbing floors or working in our cafeterias. That simply isn't good enough.

And we are making progress. A small and disadvantaged company in Houston has been awarded over $84 million to date for work on the Space Shuttle. In Palm Harbor, Florida, a minority-owned business has been awarded a $10.5 million contract to provide technical support on software and avionics for the space station. INFOSYSTEMS, a minority business in Carson, California, has a $10.5 million contract to provide 2,000 new computer systems for space station work on the West Coast.

INTEK, a woman-owned minority company in Westervile, Ohio, supplies flight ammonia flowmeters for the active thermal control system on the space station. That contract is valued at over $1.8 million. Another small and disadvantaged business in Martinsbury, West Virginia provides software support for the thermal control management system on the station, and their work is exemplary. And in Irvine, California, the Rocketdyne Division of Rockwell International has entered into a mentor-protege agreement with Metro Laser, which specializes in the design of optical instrumentation. Under the agreement, Rocketdyne will provide technical and management assistance to Metro Laser in the development of advanced instrumentation for our hypersonic aircraft research program.

But this is just a start. We know that technology doesn't just invent itself. There has to be a demand for it, a reason to pursue new inventions, new ways of doing things. And that means for NASA to succeed with President Clinton's ambitious goals for reaching out to America, we have to have a healthy, stable program capable of giving this country a return on its investment. And that brings us to funding, and making the hard choices for the future.

From the very outset of my tenure as NASA Administrator, perhaps the most pressing issue I have faced is how to allocate the agency's resources at a time when Federal spending has to be constrained. During my confirmation hearings in late March of last year, Senator Ernest Hollings of South Carolina pointed out, about two minutes into the proceedings, that NASA was going to have to prioritize its programs, and that over the next several years, something was going to have to give.

Senator Hollings was right. NASA, like all the agencies in the government, has been called upon to do its share of belt tightening, and that is why you have been hearing about a redesign of the space station. Our goal is to preserve the many other worthwhile programs we have while also providing for construction of an international laboratory in space.

In the total context of our budget over the next several years, we are going to see significant cuts in our rate of growth. NASA's budget will be almost flat, but at the same time we have to increase our investment in the renewal of American aeronautics, we have to increase our investment in space technology and the mechanisms for transferring that into the private sector. So we have to re-vector our priorities, and take a holistic approach to the entire range of space and aeronautics spending in the future.

President Clinton has challenged us to build the space station for less money, to use innovative approaches in design and management to come up with an outpost that can do the job for less. I am encouraged by the work that our redesign team has done so far, and I am convinced that we can meet President Clinton's challenge and build a world-class space station by the end of the decade.

This program has more than just a passing interest for the average American. Through our travels in space, we are learning to cope with a radically different environment. To take on that challenge, and to do it safely and effectively, requires that we advance our knowledge on many fronts. That's what I meant when I said there has to be a demand for all this high technology.

New devices and new ways of doing things don't just spring up uninvited. There have to be reasons to pursue these things, and space flight provides an essential forcing function. Let me give you an example.

Over the past several years we have been working very hard to understand what happens in the physiology of our astronauts when they go to space. There are many changes in the body, and some begin almost as soon as the astronauts get to orbit. One of those changes is a very pronounced fluid shift -- the body fluids tend to shift upwards. We want to understand why, and we want to know what that means.

So we developed a device that can be used to take measurements in orbit and beam that data remotely to doctors on the ground. The measurements are of the blood vessels in an astronaut's eyes. By studying the blood vessels in the retina, we are able to better characterize the extent of the fluid shift.

And as is so often the case, this technology has important applications here on Earth. Diabetes can damage blood vessels in the retina, and about half of the nation's estimated 14 million people with diabetes have at least early signs of this condition. Many of them come from particular ethnic groups, as with the Pima Indians of the southwest, who have a higher than average susceptibility to this condition.

We are working with one of the commercial centers for the development of space technology to make this available in rural areas, where oftentimes people do not have the capability to see a doctor, and where early treatment could enhance the quality of their lives. We have specially equipped vans that travel those rural areas, take the retinal measurements, and then transmit the data to treatment centers for diagnosis. When this kind of health care either isn't available or isn't affordable, there is a very decided relevancy to the visit of those specially equipped vans.

This is just one example, out of literally thousands, of how our research in air and space can help people here on the ground. In space, we are able to study healthy bodies reacting to a strange new environment. With gravity as a variable, we can peer in to some of the mechanisms that drive the body, and better understand things like changes in bone mass, which has broad implications for the study of osteoporosis here on Earth.

Space offers a unique window, both for studying the human body and for developing new tools and techniques for all of us to adapt and work with back here on the home planet. And there will have to be energized, excited people to carry out that work. The key to maximizing the return on this effort is to make sure that the widest possible array of people have access to it or are part of it.

That's why we have set a goal of awarding at least 8% of the total value of NASA contracts to small and disadvantaged and women-owned businesses by 1994.

We have institutionalized that goal, and we are pushing to do more every year. Part of the performance evaluations for our senior managers are based on reaching that target. In Fiscal Year 1992, we awarded 7.2% of our prime and subcontract dollars to small and disadvantaged businesses, exceeding the goal of 6.75%. In a few days, the NASA Minority Business Resource Advisory Committee I appointed will meet at the Lewis Research Center in Cleveland. This is an exciting group of people who are advising us on better and more effective ways to reach out to the culturally diverse workforce of America. And on April 19 we will hold a telecon with all of our Center Directors to review our SDB status.

In December, we announced an additional set-aside of an extra $310 million to be awarded this year to small disadvantaged businesses for high-tech work, and when the President unveils his new budget for NASA next week, you will see an even greater commitment.

In 1992, for example, NASA provided nearly $24.8 million to Historically Black Colleges and Universities, an 11% increase over the previous year. Student assistance within this funding increased 64%, enabling us to support 354 graduate students and more than 1,000 undergrads.

And I am announcing today that over the next budget planning period we intend to double the amount of money and support that will go to those minority institutions. We're not talking, we're doing.

President Clinton's budget also will include a significant advanced technology package, and I pledge to you today that it will be a package that reaches out to all our people. These will not be just a few big programs available to a few big companies. We are going to open up the process, and insist that the work is available to a culturally diverse workforce.

We will hold open meetings with minority businesses and minority colleges and universities. We will sponsor 27 SDB conferences in 22 cities this year alone. We will offer inducements to the space industry for exceeding SDB subcontract goals. We have met with the CEOs of major aerospace corporations to stress the importance of these initiatives. They have to realize that small businesses, the lean and mean hungry firms, can help them enrich their products. And as money gets tighter, they should be turning to these go-getters for more efficient and cutting-edge work, rather than trying to do everything in-house. We are serious about this. We believe it is very important not just for the health and vitality of NASA in the future, but for the country as well.

And so now we come to what you can do to help us with our goals for the cultural revolution at NASA. We need you to come to us, to work with us, to bring your own networks of talented people into the mix. We need you to work with minority entrepreneurial companies, develop your own university and industry teams and then show us what you've got.

Don't just come to us for contracts. Bring a consortium of minority entrepreneurs. Work with them to transfer this new technology into their hands, and stand back and watch the economic multipliers pile up in your local communities. Be imaginative. Pull our chain. Challenge us to help you. And work with us as we reach for the stars.

A couple of months ago I visited North Carolina A&T, one of the largest traditionally black engineering schools in the nation. In one of the labs, I met a young African-American master's student working on fuzzy logic. This is an innovative approach to computer science that is one of the methods we are using to teach machines to think like people.

If I say, "John is tall," for example, all of the humans in this room will immediately grasp that abstract concept. But if you try to tell a computer that, it will want a great many more parameters defined before it can get the meaning.

This young man's work was really fine, some of the best you will find underway in the country, and there he was, absolutely on the cutting edge! And there are applications for these things. In Japan, for example, fuzzy logic is very big, and they have led the way in exploiting it for commercial applications. Matsushita makes a washing machine with a fuzzy logic chip -- enabling the washer to sense how much dirt is in the water and set the soap, rinse and spin cycles accordingly. The Sendai subway in Tokyo uses fuzzy logic, as do Nissan auto transmissions and a variety of camcorders and cameras. This is what we are talking about when we speak of relevant technology that touches the lives of ordinary Americans -- whether it is the people who have jobs making such innovative products or the people who use the products.

In another lab at North Carolina A&T, I saw young people working on advanced composite materials for a future Mars mission, but that technology has applications in the private sector, right now, today, right here on Earth. So I challenged Ed Fort, the president of North Carolina A&T, to have his people work with minority businesses. Have the students reach out to local companies and form cutting edge teams. What better way to excite young minds, and what better way to transfer this technology to the private sector, where it belongs?

We're activating you. We're challenging you to come to us with ideas, and we'll help you put them into motion. Call Yvonne Freeman, our Associate Administrator for Equal Opportunity Programs. Call Ralph Thomas, our Associate Administrator for Small and Disadvantaged Business Utilization. Go by the NASA booth today, and ask for information on the HBCU Procurement Expo to be held at Bowie State University later this month.

We can't succeed without you. We need the young people you are training. We need their zeal, their imagination and their skills. We need them to be a part of our team, a part of our effort to make the face of NASA reflect the face of America.

And that zeal, I believe, will carry across generations. Let me leave you with two experiences. I went to Manassas, Virginia in December for the rollout of a new remotely-piloted high-altitude research aircraft called Perseus. It was developed by a small group of about 40 people who had a vision. They saw the need for vehicle that could fly higher than piloted aircraft, to altitudes well over 100,000 feet, and yet be controlled precisely, in ways that scientific balloons cannot. Twenty months and just $3 million later, their vision became reality with the Perseus, and they will open up a region of the atmosphere for study that previously was largely out of reach.

It is an excellent example of how pathfinding science can be done at low cost if we use imagination and ingenuity. But what really struck me about the ceremony was the group of people who put this program together. I expected to find a gathering of gray hair and suits, maybe a few overstuffed pocket protectors and people mumbling about red tape in government. But what I found instead were excited young engineers, male and female, holding their babies or leading toddlers by the hand for what was a real celebration of achievement. There were young female engineers holding their babies in their arms, including them in the moment, because this was an important event in their lives, so much so that they brought their children to share it. And I believe those children will remember.

It's the same kind of reaction I experienced when I accompanied Dr. Mae Jemison to the Challenger Boy's and Girl's Center in South Central Los Angeles. When Mae Jemison grew up in the 1960s, there were no black astronauts, there were no female astronauts. But that didn't matter. Dr. Martin Luther King had a dream, and Mae Jemison had a dream, too.

When we arrived it was late afternoon and there were 150 children there, most of them fidgety and ready to go home. The kids were Hispanic American, African American and Asian Americans between the ages of 8 and 14. When I spoke, I was very excited and I told them all about space and really tried to get their juices flowing. They gave me a polite applause.

But when I introduced Mae Jemison, I want to tell you that for five minutes these children were uncontrolled in their emotional outburst. It was a powerful moment. But understand what was happening. Here was a role model, here was a 35 year-old African American woman who was selected to be the best among the very best. And these children instantly understand the implication of this woman's flight into space. She was one of them, she excited them, and without question she inspired them. They immediately grasped the implication that the same kind of journey was possible for them.

If we are truly going to make this America's space program, then it has to reflect the dreams and aspirations of all Americans. Everybody in America has a dream. And we can all make it happen if we commit to the dream.

Thank you very much.

NASA News

National Aeronautics and
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Washington, D.C. 20546
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ISY

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Headquarters, Washington, D.C.
(Phone: 202/358-1757)

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RELEASE: 93-65

NASA, OTHER AGENCIES TO EXPLAIN TECHNOLOGY REINVESTMENT

The DOD's Advanced Research Projects Agency, in collaboration with NASA, Commerce Department's National Institute of Standards and Technology, the Department of Energy and the National Science Foundation today announced the details of regional meetings planned under the White House Technology Reinvestment Project.

The project is a $471 million interagency effort to develop dual-use technologies and to help small defense firms make the transition to commercial manufacturing. The project programs are structured to expand high quality job opportunities in commercial and dual-use industries and to demonstrably enhance U.S. competitiveness. The project is part of President Clinton's $1.7 billion Defense Reinvestment and Conversion Initiative.

During these meetings, Technology Reinvestment Project officials from the five agencies will be available to explain the project and answer questions.

Federal, state and local officials participating in each meeting will hold a media availability at approximately 11:30 a.m. daily at the meetings. Call one of the below points of contact to verify the media availability time for a specific meeting.

Media interested in attending one of the regional meetings should preregister with the host organization listed below or with the Department of Defense Public Affairs at 703/695-0192. Media may obtain an information packet on the Technology Reinvestment Project by calling 1-800-DUAL-USE or by contacting NASA or DOD Public Affairs or the host organization.

- April 12 -- Sheraton New York Hotel and Towers, 811 Seventh Ave. at 52nd Street, New York, N.Y. The media availability will be held in the Versailles Terrace room. The press room will be the Versailles Ballroom. Point of contact for preregistration and more information is Martha Quinn, with the Northeast-Midwest Institute, 202/226-3920.

- more -

- April 13 -- Weston Hotel, Renaissance Center, Jefferson Avenue, Detroit, Mich. The media availability will be held in the Michelangelo room. The press room will be the Monet room. Point of contact for preregistration and more information is Tim McNulty, with the Council of Great Lakes Governors at 312/407-0177.

- April 14 -- Hyatt Orlando, 6375 West Irlo Bronson Memorial Highway, Kissimmee, Fla. The media availability will be held in the Polk City room. The press room will be the St. Cloud room. Point of contact for preregistration and more information is Colleen Cousineau, with the Southern Legislative Conference at 404/266-1271.

- April 15 -- Radisson Hotel, Central Dallas, 6060 North Central Expressway, Dallas, Texas. The room for the media availability is yet to be determined. The press room will be the North Park Board Room. Point of contact for preregistration and more information is Kathy Schwartz, with the Texas Department of Commerce at 512/320-9559.

- April 16 -- Biltmore Hotel, 506 South Grand Avenue, Los Angeles, Calif. The media availability will be held in the Heinsbergen room. The press room will be the Cordoban room. Point of contact for preregistration and more information is Susan Pasternak, with the Los Angeles Area Chamber of Commerce at 213/629-0650.

Each meeting will have a similar agenda. All times are local.
8:00 a.m. to 12:30 p.m. Registration
Welcoming remarks by federal official
12:45 p.m. Remarks by local and state officials
1:30 p.m. Overview of Technology Reinvestment Project
2:30 p.m. Break
2:45 p.m. Beginning of break-out meetings on Technology Development and Technology Deployment and Manufacturing Education and Training, running concurrently.
5:45 p.m. Break-out meetings end, conference adjourns

Media should address questions to the specific participating agency:

- Advanced Research Projects Agency, DOD Public Affairs, 703/695-0192
- National Inst. of Standards and Technology, Public Affairs, 301/975-2758
- Dept. of Energy (Defense Programs), Public Affairs Office, 202/586-0597
- National Science Foundation, Public Affairs Office, 202/357-9498
- NASA, Advanced Concepts & Technology Public Affairs, 202/358-1757

Industry and other institutions representatives interested in attending or receiving an information packet should call 1-800-DUAL-USE.

-end-

NASA News

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ISY

For Release

Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/358-0883)

April 9, 1993

Major Mike Doble
Department of Defense, Washington, D.C.
(Phone: 703/693-1778)

RELEASE: 93-66

CLEMENTINE MISSION SCIENCE TEAM SELECTED

NASA today announced the selection of the science team for the Clementine mission to orbit the moon and to visit an asteroid.

The team will be headed by Dr. Eugene Shoemaker of the U.S. Geologic Survey, Flagstaff, Ariz., who has been very active for many years in both lunar and asteroid research.

Clementine, sponsored by the Strategic Defense Initiative Office (SDIO), will launch a small spacecraft in January 1994 to orbit the moon for several months, then de-orbit the moon in early May 1994. The spacecraft would then fly by the near-Earth asteroid 1620 Geographos on Aug. 31, 1994, when the asteroid is several million miles away, its closest distance to the Earth.

The goals of the mission are to test new, lightweight sensors in a space radiation environment and to demonstrate autonomous navigation and spacecraft operation. Lightweight and innovative spacecraft components also will be tested, including a lightweight star tracker, an inertial measurement unit, lightweight reaction wheels for attitude control, as well as a lightweight nickel hydrogen battery and a lightweight solar panel.

The science team will plan for the acquisition of the scientific measurements, the archiving of all science data in a form easily accessible to the planetary science community and initial analyses of the data.

Geographos is one of the earliest discovered Earth-crossing asteroids. It was discovered in September 1951, in a sky survey sponsored by the National Geographic Society. Most Earth-crossing asteroids are thought to be fragments produced by collisions between asteroids in the main belt between Mars and Jupiter, which are later perturbed into Earth-crossing orbits.

- more -

Radar images recently obtained of the asteroid 4179 Toutatis suggest that the shape of Geographos and other Earth crossers might be much more complex than previously suspected.

The sensors will be trained on the moon and on the asteroid. Also, mutispectral science measurements at ultraviolet, visible and infrared wavelengths will be made and played back to Earth. The specific filter wavelengths were selected in consultation with NASA scientists, to both meet SDIO objectives and maximize the scientific data return.

The science team members selected and their affiliations are:

Charles Acton, Jet Propusion Laboratory, Pasadena, Calif.
Daniel Baker, Goddard Space Flight Center, Greenbelt, Md.
Jacques Blamont, CNES (France)
Bonnie Buratti, Jet Propusion Laboratory, Pasadena, Calif.
Merton Davies, Rand Corp., Santa Monica, Calif.
Thomas Duxbury, Jet Propusion Laboratory, Pasadena, Calif.
Eric Eliason, U.S. Geologic Survey, Flagstaff, Ariz.
Paul Lucey, University of Hawaii, Honolulu
Alfred McEwen, U.S. Geologic Survey, Flagstaff, Ariz.
Carle Pieters, Brown University, Providence, R.I.
David Smith, Goddard Space Flight Center, Greenbelt, Md.
Paul Spudis, Lunar and Planetary Institute, Houston

The Naval Research Laboratory, Washington, D.C., is responsible for mission design, providing the spacecraft and for mission operations. The Jet Propulsion Laboratory will be responsible for tracking the spacecraft radio signal using NASA's Deep Space Network and will be responsible for accurately locating Geographos using its Near Earth Object Center in preparation for the flyby.

- end -

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For Release April 13, 1993

RELEASE: 93-067

COMPUTER PROGRAM WILL CATALOG ASTRONOMICAL SKY SURVEY

Scientists at NASA's Jet Propulsion Laboratory (JPL) and the California Institute of Technology (Caltech), both in Pasadena, Calif., announced today that they have developed a computer software system to catalog and analyze the estimated half billion sky objects in the second Palomar Observatory sky survey.

The survey of the northern sky includes more than 3,000 digitized photographic plates produced by Palomar, located in San Diego.

Drs. Usama Fayyad and Richard Doyle of JPL said the system, called Sky Image Cataloging and Analysis Tool (SKICAT), will be delivered to Caltech this month. SKICAT is based on state-of-the-art machine learning, high performance database and image processing techniques.

Caltech astronomer Professor S. Djorgovski said each photographic plate is being digitized into 23,040 by 23,040-pixel images at the Space Telescope Science Institute, Baltimore. The resulting data set will not be surpassed in quality or scope for the next decade, he said.

"The sky object classification task is manually forbidding. The plates contain hundreds of millions of sky objects. Humans are unable to visually process the fainter objects in the survey," Djorgovski said.

Fayyad said the core of the new system includes two integrated machine learning mathematical formulas, called algorithms. These algorithms automatically produce decision trees for the computer based on astronomer-provided training data or examples. A machine learning program learns to classify new data based on training data provided by human experts.

- more -

Caltech astronomer Nick Weir and Fayyad said SKICAT has a correct sky object classification rate of about 94 percent, which exceeds the performance requirement of 90 percent needed for accurate scientific analysis of the data.

By contrast, Fayyad said, the best performance of a commercially available learning algorithm was about 75 percent. By training the learning algorithms to predict classes for faint astronomical objects on the survey plates, the algorithms can learn to classify objects that actually are too faint for humans to recognize.

The training data for faint objects was obtained from a limited set of charge coupled device images taken at a much higher resolution than the survey images, Weir said.

The SKICAT system will produce a comprehensive survey catalog database containing about one-half billion entries by automatically processing about three terabytes (24 trillion bits, 8-bits to a byte) of image data.

Since SKICAT can classify sky objects that are too faint for humans to recognize, the SKICAT catalog will contain a wealth of new information not obtainable using traditional cataloging methods, Weir said. Because sky objects up to one visual magnitude fainter now can be processed, the number of classified catalog entries will be approximately three times larger than has been possible so far with other techniques.

"Some historical sky object classification tasks performed over a period of years could now be achieved in a few hours," Weir said.

One major benefit of this program includes freeing astronomers from the tedium of an intensely visual and manual task so they may pursue more challenging analysis and interpretation problems, according to Djorgovski.

"This is an excellent example of the use of machine learning technology to automate an otherwise infeasible task of dealing with an amount of data that is simply overwhelming to humans," Fayyad said. "SKICAT represents a new generation of intelligent trainable tools for dealing with the huge volumes of scientific image data that today's instruments collect."

"We view SKICAT as a step towards the development of the next generation of tools for the astronomer of the turn of the century and beyond," Djorgovski said.

-end-

News

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Headquarters, Washington, D.C.
(Phone: 202/358-0883)

For Release April 14, 1993

James H. Wilson
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RELEASE: 93-068

OZONE DESTROYING CHLORINE EXISTED LONGER IN 1992-93 WINTER

Ozone-destroying forms of chlorine existed for much longer in the Arctic stratosphere this winter than last, say scientists.

Northern Hemisphere ozone abundance also was observed to be some 10 percent below that measured during the same period last year, with some regions 20 percent lower.

Using NASA's Upper Atmosphere Research Satellite (UARS), Dr. Joe Waters and his colleagues at the Jet Propulsion Laboratory (JPL), Pasadena, Calif., and Edinburgh University, Scotland, have collected daily maps of ozone and other gases and of temperature in different layers of the stratosphere. One of their most critical measurements is of chlorine monoxide, a form of chlorine that destroys ozone. They reported the results in the international scientific journal Nature.

"Ozone concentrations in the Arctic in a layer about 12 miles (20 kilometers) high, where most chlorine monoxide was located, decreased by 0.7 percent per day from mid-February through early March 1993," Waters said. Ozone levels normally increase in this area at this time of the year, he added.

Chlorine already in the stratosphere, from chlorofluorocarbons, is converted to ozone-destroying forms by chemistry occurring on clouds which form at low temperature.

Last year, the scientists measured large abundances of chlorine monoxide in the Arctic, but the concentrations decreased after the stratosphere warmed in late January. This winter, the stratosphere remained cold through February, and chlorine monoxide remained abundant through early March.

- more -

About as much chlorine monoxide was seen in the northern polar regions in February 1993 as was measured at the South Pole before the 1992 Antarctic ozone hole formed.

"We do not see a well-defined area of ozone loss that could be described as an Arctic ozone hole," Waters said, "but the smaller abundances of ozone seen throughout the Northern Hemisphere this winter raise the question of whether the chlorine destruction of ozone has been spread over a wider area." Record low values of ozone also have been reported recently by the World Meteorological Organization and Environment Canada.

The microwave limb sounder aboard UARS was developed and is operated by JPL, led by Waters and sponsored by NASA's Office of Mission to Planet Earth. Additional members are from Edinburgh University, Heriot-Watt University and the Rutherford-Appleton Laboratory in the United Kingdom.

UARS, launched Sept. 12, 1991, aboard Space Shuttle Discovery, is managed by NASA's Goddard Space Flight Center, Greenbelt, Md.

- end -

EDITORS NOTE: A video and three color-map images are available by calling NASA Headquarters Broadcast and Imaging Branch on 202/358-1900.

The photo numbers are:

Color	B & W
93-HC-134	93-H-146
93-HC-135	93-H-147
93-HC-136	93-H-148

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For Release

April 15, 1993

RELEASE: 93-069

NASA SPACE SUIT AND MEDICAL TECHNOLOGIES HONORED

NASA technology, developed to keep astronauts cool on the lunar surface, and a NASA patient-monitoring device, originally designed for astronaut heart rate transmittal, tomorrow are being inducted into the U.S. Space Foundation's Technology Hall of Fame. The ceremonies are part of the Foundation's annual convention in Colorado Springs, Colo.

The honors will be accepted by John Samos, former head of the technology transfer office at NASA's Langley Research Center, Hampton, Va., and Thayer Sheets, a technology transfer specialist at the time of the transfers to industry. NASA Administrator Daniel S. Goldin will be the keynote speaker at the banquet.

Liquid-cooled garments

Through the efforts of Langley and a national charitable organization, the liquid-cooled garments used by astronauts were transformed into cool suits used for medical applications.

The original garments were worn inside space suits to maintain body temperature at comfortable levels. A battery-powered pump circulated water through tubes in the suit and through a chiller mechanism in the suit backpack. Work which led to this approach was originally done at NASA's Ames Research Center, Mountain View, Calif., and at the then Manned Spacecraft Center (now Johnson Space Center), Houston.

Langley adapted the technology to meet medical needs. Now it is used for patients suffering from multiple sclerosis and related neurologic disorders, cystic fibrosis, and hypohidrotic extodermal dyspiasia (HED), a condition where the victim has no sweat glands.

- more -

Through the efforts of the HED Foundation and its founder, Sarah Moody, and NASA Langley staff, 108 of the cooling suits have been donated to children without sweat glands.

In addition, about 300 suits have been sold to multiple sclerosis patients since 1991. The U.S. Army used 400 liquid-cooled garments for personnel during the Persian Gulf conflict, and the suits are used by race car drivers, hazardous materials handlers, nuclear reactor workers, and paper mill and shipyard personnel. The technology spinoff has created a multi-million-dollar industry.

Patient Monitoring Device

The patient monitoring device was first developed by the Sierra Research Corp., under sponsorship of the U.S. Air Force and Army. It was later adopted and improved upon by NASA. The monitoring technology enabled the transmission of information about the wearer's physiological condition from a remote site to a medical center. In the case of NASA, it is used to transmit astronaut heart rate and breathing rates.

This system is still in use for astronaut monitoring but has expanded in scope to include the remote transmittal of patient information from locations around the planet. With the technology, heart patients can return to their own homes but still be monitored by nurses at a hospital.

For more than 30 years, NASA's Technology Utilization Program has actively encouraged the secondary, or spinoff, application of technology originally developed for aerospace purposes. During this 3-decade period more than 30,000 aerospace innovations have found their way into common use. Collectively, these spinoffs represent a substantial return on the aerospace investment in terms of economic gain, lifestyle enhancement and solutions to problems of general public concern .

Since 1988, the U.S. Space Foundation has selected space technologies that have made significant social and economic impact for inclusion in their Space Hall of Fame. Currently, there are 14 other technologies listed in the Hall.

- end -

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ISY

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For Release
April 19, 1993

RELEASE: 93-70

JEFF LAWRENCE APPOINTED TO HEAD LEGISLATIVE AFFAIRS FOR NASA

NASA Administrator Daniel S. Goldin announced today the appointment of Jeff Lawrence, a senior congressional staff aide with extensive experience in space and aeronautics matters, as the agency's Associate Administrator for Legislative Affairs.

"With his considerable knowledge of the legislative and appropriations processes, as well as space, environmental and technology issues, Jeff Lawrence is ideally suited to serve as NASA's chief representative to the Congress today," Goldin said.

Mary D. Kerwin, currently the acting head of Legislative Affairs, has been named that office's Deputy Associate Administrator for Programs.

Lawrence last served on Capitol Hill as Legislative Director for former Rep. Bill Green of New York. In that capacity, he was Rep. Green's chief staff member on the House Appropriations Committee and its Subcommittee on Veterans, HUD and Independent Agencies, which has authority over NASA's budget. Rep. Green was the ranking minority member of the subcommittee.

Currently, Lawrence is at The George Washington University as Special Assistant to the President for Federal Affairs. In that position, he serves as an advisor to the president, faculty and administration on issues before Congress that are important to the university and its research needs.

Lawrence has substantial experience in developing legislative strategies and drafting specific pieces of legislation and amendments to implement them. He traveled extensively for the subcommittee to oversee NASA's programs.

Working with the staffs of the full appropriations committee and the subcommittee, Lawrence helped develop appropriations bills, supplemental proposals and conference reports and assisted the congressman in managing these matters on the House floor.

- more -

Prior to joining Rep. Green in 1983, Lawrence was a Legislative Assistant to Sen. Daniel K. Akaka of Hawaii, when he was a member of the House, and to former Rep. Norman E. D'Amours of New Hampshire. In these positions he advised the members on environmental, energy and agricultural issues.

A 1972 graduate of Colby College, Waterville, Me., Lawrence taught English and history and coached track in Kittery, Me. In 1990 and 1992, he received awards from the Council of Large Public Housing Authorities for service to low-income housing and its residents. In 1987, he was selected to participate in an exchange program between the U.S. Congress and the West German Bundestag.

- end -

NASA News

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For Release
April 20, 1993

EDITORS NOTE: N93-20

NASA TO HOLD ASTRONOMY, OZONE-RESULTS BRIEFINGS

NASA will hold two press briefings on Thursday, April 22, to highlight findings from the Compton Gamma Ray Observatory and the Mission to Planet Earth Program.

The first press conference, scheduled for 11:30 a.m. EDT at the Visitor's Center of the Goddard Space Flight Center (GSFC), Greenbelt, Md., will discuss record low global ozone levels observed in 1992. *Information presented in this briefing is embargoed until 6 p.m. Thursday, April 22.*

Dr. James Gleason of Universities Space Research Association (USRA) will discuss the results, scheduled to appear in the journal *Science* on Friday, April 23. Also on the panel will be Dr. Rich McPeters, Nimbus-7 Project Scientist, of GSFC; Dr. Richard Stolarski of GSFC; and Dr. Jim Miller of the National Oceanic and Atmospheric Administration.

To reach the GSFC Visitors' Center from Washington, take I-295 north to the Greenbelt Road exit. Turn left onto Soil Conservation, and the Visitors' Center will be on the left approximately one-quarter mile after the turn.

The second press conference, at 1 p.m. in the NASA Headquarters Auditorium, Washington, D.C., will highlight new findings from NASA's Compton Gamma Ray Observatory. The new findings, including the highest energy gamma-rays ever recorded from a burst, challenge long-standing theories about these bewildering bursts and question their origins.

- more -

The auditorium is located on the first floor of NASA Headquarters, 300 E Street, S.W., Washington, D.C.

Presenting the discoveries will be Dr. Brenda Dingus, USRA, Greenbelt, Md., and Dr. Chryssa Kouveliotou, USRA, Huntsville, Ala. Commenting on the significance of these discoveries will be Dr. Stan Woosley, Lick Observatory, Santa Cruz, Calif.; Dr. Bruce Margon, University of Washington, Seattle, and Dr. Steve Maran, GSFC.

Three color images, two artists concepts of gamma-ray burst models and a 1:12 minute video will be available to the media through NASA's Broadcast and Imaging Branch, (202) 358-1900 on Thursday, April 22, 1993.

Reporters will be able to cover both press briefings from either location. Reporters wishing to come to NASA Headquarters can see the Goddard press conference and ask questions from the 8th floor conference room. Seating in this conference room is limited, so reporters may wish to go to the Goddard Visitors' Center, which will remain open following the first press briefing to allow reporters to see and participate in the Space Astronomy Update.

This event will be carried live on NASA Select television, Satcom F-2R, Transponder 13, located at 72 degrees West Longitude, frequency 3960.0 MHz, audio 6.8 MHz. Questions will be taken from other NASA centers.

- end -

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For Release

Drucella Andersen
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April 20, 1993

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RELEASE: 93-071

NASA SR-71 NOW A FLYING OBSERVATORY

NASA has modified a former Air Force reconnaissance aircraft to conduct high-altitude astronomy studies at three times the speed of sound.

The SR-71A "Blackbird," based at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif., made its first science flight on March 9. In the plane's nose bay was an ultraviolet video camera that studied stars and comets. Future flights will carry a variety of instruments, including a fiber optics device and an ultraviolet spectrometer.

"This really is a case of turning swords into plowshares," said Jacklyn Green, Project Scientist for the SR-71 science research platform project at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., which developed the experiments. "We are taking what was once a spy plane and transforming it into a useful, cost-effective science platform. This opens up a new ultraviolet window for research."

During its first mission, the SR-71 climbed to just above 83,000 feet (25.3 kilometers), where scientists can observe stars and planets at ultraviolet wavelengths that are blocked to ground-based astronomers.

The SR-71 could perform several other experiments now in the planning stage, such as infrared studies of the Aurora Borealis by the University of California, Los Angeles Physics Department and atmospheric science studies of specific pollutants in the stratosphere.

"It's significant to the SR-71 program that the unique capabilities of the aircraft are being viewed by the science community as a platform for gathering data at high speeds and altitudes. The SR-71 is the only aircraft that can meet their needs," said Dave Lux, SR-71 Project Manager at Dryden.

- more -

NASA's three Blackbirds also may serve as platforms for aeronautics studies in NASA's High-Speed Research Program. "Boeing is investigating the possibility of using the SR-71 for inlet testing with a subscale engine and supersonic riblet testing, and McDonnell Douglas is interested in conducting sonic boom studies," said Neil Matheny, Dryden point of contact for the program.

The High Speed Research program is researching and developing technology for a future environmentally friendly, economically feasible high-speed civil transport. The program is a joint NASA-industry effort led by NASA's Langley Research Center, Hampton, Va.

- end -

NOTE TO EDITORS: Video and still photos of the SR-71's first science flight are available to media representatives by calling the NASA Headquarters Broadcast and Imaging Branch on 202/358-1900.

Color:	93-HC-94	93-HC-95
B&W:	93-H-106	93-H-107

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ISY

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For Release
April 21, 1993

NOTE TO EDITORS: N93-21

STS-55 NASA NEWSROOM HOURS AND PROCEDURES FOR AFTER-HOURS NEWS CONFERENCE PARTICIPATION

During Shuttle Mission STS-55, the NASA newsrooms supporting the flight will have extended hours of operation. However, staffing and budget constraints will force some NASA newsrooms to be closed in the evenings and on weekends.

To permit media to ask questions in daily mission press briefings, the following procedures are to be used when a newsroom is closed and it is not possible for the media to ask questions directly of press conference briefers.

Media should write down their name, affiliation and question(s) and facsimile the question(s) to the newsroom at the NASA center originating the briefing at least 1/2 hour prior to the start of the news conference. Facsimile numbers are listed in this release. The question(s) will be given to the appropriate briefer who will read the question over NASA select and answer it or refer it to the appropriate expert. Newsroom personnel WILL NOT forward verbal question to the briefing participants.

In an effort to facilitate the flow of communications, listed below are the times each newsroom will be open along with contact phone numbers:

-more-

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For Release

Jeff Vincent
Headquarters, Washington, D.C.
(Phone: 202/358-1400)

April 22, 1993

NASA STATEMENT ON ADVISORY COMMITTEE MEETING

NASA Administrator Daniel S. Goldin today announced that Bryan O'Connor, Deputy Director of the Space Station Redesign Team, will manage the effort so that a request by Dr. Joseph F. Shea, the team's leader, to reduce his workload can be accommodated.

In a letter to Goldin today, Shea submitted his resignation as Assistant Deputy Administrator for Space Station Analysis. He will transition to a role as Special Advisor to the Administrator and advisor to O'Connor.

"I greatly appreciate Joe's help and willingness to continue to contribute to an effort that is critical to this nation's future in space," Goldin said.

The Advisory Committee on the Redesign of the Space Station, chaired by Dr. Charles M. Vest, held its first public meeting today in Arlington, Va. They received a comprehensive status report from the NASA Redesign Team, including an introductory presentation from Shea. Briefings also were presented on space station missions and requirements; science, technology and engineering research; current option development and plans; and by the international partners on redesign considerations to date.

"Today's meeting of the Advisory Committee was extremely productive," Goldin said. "The redesign effort is on track, and I am especially gratified by the terrific job being done by Bryan O'Connor and the rest of the NASA Redesign Team."

\- end -

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For Release

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April 22, 1993
EMBARGOED UNTIL 1 P.M. EDT

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RELEASE: 93-72

NASA SATELLITE DATA SHAKE THEORIES ON GAMMA-RAY BURSTS

New findings from a NASA satellite indicate that powerful gamma-ray bursts, one of the great mysteries of astronomy, may be more energetic than previously thought and appear to originate far beyond the Milky Way galaxy.

The new data from the Compton Gamma-Ray Observatory raise the possibility that the bursts of high energy radiation may be caused by unknown objects or phenomena in the universe, scientists said at a press conference today at NASA Headquarters, Washington, D.C.

"These results eliminate some theoretical models entirely and produce severe constraints on other possible theories" about the source of the gamma-ray bursts, said Dr. Carl E. Fichtel of NASA's Goddard Space Flight Center, Greenbelt, Md. He is the co-principal investigator for one of the satellite's instruments, the Energetic Gamma Ray Experiment Telescope (EGRET).

The critical new data include observations of the highest energy gamma-rays ever recorded in a burst.

A 2-year mapping survey by another satellite instrument, the Burst and Transient Source Experiment (BATSE), show that the bursts are evenly distributed in space. BATSE has seen an average of one gamma-ray burst a day since the observatory was launched on April 5, 1991. As of March 23, 1993, 591 bursts have been recorded.

- more -

The pattern of the bursts on the sky has shown them to be distributed like no other known objects in the Milky Way, indicating that they may originate outside the galaxy, said Dr. Chryssa Kouveliotou, a BATSE team member who works for Universities Space Research Association, a contractor at NASA's Marshall Space Flight Center, Huntsville, Ala.

Super Bowl Burst

An important clue to the puzzle was obtained on Jan. 31, 1993, when EGRET recorded a gamma-ray burst that was 10 times higher in energy than any previously observed since the launch of Compton. The burst -- dubbed the "Super Bowl Burst" because it was seen on Super Bowl Sunday -- was more than 100 times brighter at its peak than the brightest steady source of gamma rays in the Milky Way galaxy and more than 1,000 times brighter than any other known sources outside the Milky Way.

Aside from its extreme brightness, this event is similar in most other respects to the other bursts recorded by Compton and earlier satellites. Because bursts this bright are relatively rare and the EGRET experiment views only a small portion of the sky at a particular time, astronomers were incredibly lucky to have this event occur when EGRET was pointed in that general direction. The nature of the burst indicates that many more may be occurring than scientists detect.

"The EGRET observation of the highest-energy gamma rays suggests they may be emitted in a small beam, like a spotlight, to escape the source," said Dr. Brenda Dingus, an EGRET team member who works for Universities Space Research Association at Goddard. "However, to observe such a small beam, it must be pointed at us. So there may be many more objects emitting gamma-ray bursts that we do not see because their beams point elsewhere."

Both the BATSE and EGRET results undercut the two most widely accepted models that attempted to explain gamma-ray bursts prior to Compton's launch.

One model says the bursts are energy releases from neutron stars and are confined to the Milky Way galaxy and a region, or "halo," surrounding it. A neutron star is the small, extremely dense remnant core of a star that has exploded in a supernova. Since the Earth is in the outer suburbs of the Milky Way, more bursts should be seen toward the more densely populated center of the galaxy than elsewhere, according to this model.

"But that hasn't turned out to be the case. Gamma-ray bursts do not seem to cluster in a preferred region of the sky," said Kouveliotou. "These bursts are emitted from all directions and vary greatly in intensity and time structure."

Colliding Black Holes

Another model suggests that gamma-ray bursts emanate from the distant reaches of the universe, possibly the result of stars exploding or neutron stars or black holes colliding. Black holes are believed to be stars that have collapsed to such high density that light cannot escape their resulting super-gravity. Many of these models predict that the gamma rays are the thermal energy from the hot, glowing body produced in these explosions or collisions. But the gamma rays seen by EGRET from the Super Bowl Burst are not of the thermal type.

"This begs the question -- If these collisions or explosions are not the source of gamma-ray bursts, what are? We don't know yet," said Marshall's Dr. Gerald Fishman, the BATSE Principal Investigator. "It is possible that some new object or phenomenon is producing these bursts."

Fishman said the Compton data will be studied by scientists from around the world who are seeking to unravel the puzzle of gamma-ray bursts.

"It's difficult to say exactly where this new information will lead," said Fishman, "but it's probably safe to assume that we'll have to rewrite the textbook on gamma-ray bursts."

The Compton Gamma-Ray Observatory is managed by Goddard Space Flight Center for the Office of Space Science at NASA Headquarters, Washington, D.C. BATSE was developed by Marshall Space Flight Center. EGRET was developed by Goddard.

- end -

Editors Note: Three color images, two artists concepts of gamma-ray burst models and a 1-minute, 12-second video are available to media representatives through NASA's Broadcast and Imaging Branch (202/358-1900).

Color	B&W
93-HC-166 thru 93-HC-169	93-H-178 thru 93-H-182

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For Release

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April 23, 1993

RELEASE: 93-73

NASA ENGINEER RECEIVES TECHNOLOGY TRANSFER AWARD

A senior design engineer at NASA's Lewis Research Center, Cleveland, was awarded the Federal Laboratory Consortium Award of Excellence in Technology Transfer for 1993.

Richard T. Barrett, an engineer in Lewis' Structural Systems Division, was one of 28 government employees who was awarded the plaque in ceremonies in Pittsburgh.

The Federal Laboratory Consortium awards recognize U.S. federal laboratory employees who have done an outstanding job of transferring technology developed in their government laboratory to outside users such as other government agencies or the private industry sector.

Barrett's recognition is based on his preparation of the first comprehensive fastener design manual, created for use by design engineers in the aerospace and construction industries. In the last 3 years, more than 5,000 copies of this document have been placed in engineering offices.

Fasteners, such as screws, nuts, and bolts, are some of the most important features in the design of all hardware. On a typical desktop computer there are as many as 30 fasteners that attach peripheral devices to the computer motherboard and to the case. With proper selection of a fastener, a technician can assemble the computer in 30 minutes. With an improper selection, the assembly process can take as long as several hours.

Barrett's manual assists the designer in selecting the proper fastener by providing correct configuration data on fastener sizes, types, materials, reliability and performance.

- end -

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For Release

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April 22, 1993
Embargoed until 6 p.m.

Allen Kenitzer
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RELEASE: 93-74

1992-93 GLOBAL OZONE LEVELS LOWER THAN ANY PREVIOUS YEAR

In the second half of 1992, global ozone levels were 2 to 3 percent lower than any previous year and 4 percent lower than normal, based on extensive data analysis from NASA's Nimbus-7 satellite.

"We are seeing lower global ozone values than we've ever seen before," said James F. Gleason, Ph.D., an atmospheric scientist with the University Space Research Association working at NASA's Goddard Space Flight Center, Greenbelt, Md. "We predicted lower ozone in 1992, but nothing like the values we actually observed."

The very lowest levels were observed in December 1992 when the global average was approximately 280 Dobson units. By comparison, a normal December value is about 293 Dobson units. Previously, the lowest level of 286 Dobson units was observed in December 1987.

Ozone, a molecule made up of three atoms of oxygen, is located primarily in the upper atmosphere, where it absorbs harmful ultraviolet radiation from the sun. A Dobson unit is the physical thickness of the ozone layer if it were brought to the Earth's surface (300 Dobson units equals 1/10th of an inch or 3 millimeters).

Extensive analysis of independent data from the National Oceanic and Atmospheric Administration (NOAA-11) Solar Backscatter Ultraviolet spectrometer (SBUV/2) and the Russian Meteor-3 Total Ozone Mapping Spectrometer (TOMS) instrument confirm the Nimbus-7 TOMS data. Comparison of all systems with the ground-based World Standard Dobson Instrument and the Dobson network indicates that the satellite instrument measurements are consistent during the period.

- more -

Northern Hemisphere Mid-Latitudes

The 1992 ozone levels were especially low in the mid-latitudes of the northern hemisphere. The December 1992 mid-latitude ozone levels were 9 percent below normal. The low mid-latitude ozone values continue into 1993. The January 1993 ozone levels were 13-14 percent below normal. Preliminary observations of March 1993 mid-latitude ozone show that the levels continue to be 11 to 12 percent below normal.

Preliminary results from the Shuttle Solar Backscatter Ultraviolet (SSBUV) instrument, flown as part of the recent ATLAS 2 mission, also observed low springtime, northern hemisphere ozone levels in agreement with Nimbus-7 TOMS. Only in the equatorial region were ozone values well within the range of the previous year's data.

Scientists say they can only speculate on the cause of the 1992 low ozone values. While the exact cause is unknown, the low ozone may be related to the continuing presence of particles produced in the upper atmosphere following the eruption of Mount Pinatubo in the Philippines in June 1991. The results of this ozone data analysis will be published in Science magazine.

The Nimbus-7/TOMS has measured ozone levels since November 1978 and continues to be the primary monitor of global ozone levels. The NASA TOMS instrument on the Russian Meteor-3 satellite was launched in August 1991. The NOAA-11 SBUV/2 has measured ozone since January 1989. The SSBUV has flown annually on the Space Shuttle since 1989.

The TOMS instruments, the Nimbus-7 satellite and the SSBUV project are managed by the Goddard Space Flight Center for NASA's Office of Mission to Planet Earth, Washington, D.C.

Mission to Planet Earth is NASA's long term, coordinated research effort to study the Earth as a global environmental system. It is comprised of satellites such as Nimbus-7 and UARS, Space Shuttle missions such as this month's flight of ATLAS-2 and airborne and ground-based studies.

The NOAA-11 SBUV/2 instrument was launched in December 1988 and is one of a sequence of operational ozone measuring instruments on board the NOAA operational spacecraft series. The spacecraft and instruments are managed by NOAA/National Environmental Satellite Data and Information Service. The data processing and evaluation is a cooperative NOAA-NASA effort.

- end -

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For Release

Drucella Andersen
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April 22, 1993

Don Nolan
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RELEASE: 93-75

NASA F-15 MAKES FIRST ENGINE-CONTROLLED TOUCHDOWN

With its flight controls deliberately locked, a NASA F-15 research aircraft yesterday touchdown using only engine power for control at NASA's Ames-Dryden Flight Research Facility, Edwards, Calif.

The milestone flight was part of a NASA project to develop a computer-assisted engine control system that lets a plane land safely with only engine power if its normal control surfaces such as elevators, rudders or ailerons are disabled.

"After several incidents where hydraulic failures caused aircraft to lose part or all of their flight controls, including the crash of a United Airlines DC-10 at Sioux City, Iowa in 1989, we started work on developing this automatic engines-only control system. Within a few months, I was pretty sure we could make it work, but I wasn't sure we would get a chance to fly it," said Bill Burcham, Chief of Dryden's Propulsion and Performance Branch.

"Now that the technology is proven, I hope to see it incorporated into future aircraft designs," Burcham added. "I also hope it never has to be used."

Changes to the NASA F-15's digital flight control system include a cockpit panel with two thumb-wheel controls, one for pitch (nose up and down) and the other for banking (turn) commands. The system converts the pilot's thumb-wheel inputs into engine throttle commands.

The flight control system automatically programs the engines to turn the aircraft, climb, descend and eventually land safely by varying the speed of the engines one at a time or together.

- more -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 358-1600

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For Release

April 23, 1993

RELEASE: 93-76

HUBBLE TELESCOPE SERVICING MISSION SCHEDULED FOR ELEVEN DAYS

The December flight of Endeavour on Space Shuttle mission STS-61 to service the Hubble Space Telescope (HST) has been scheduled as an 11 day mission designed to accommodate a record five spacewalks with the capability for an additional two, if needed.

The decision to schedule five extravehicular activities, or EVAs, was reached following extensive evaluations of underwater training, maneuver times required using the Shuttle's robot arm based on software simulations and actual EVA tasks on previous missions.

"Basically what we've done by going to five EVAs rather than three is to repackage our margin so that we have the capability to respond to the dynamics, or unknowns, of spacewalks," Mission Director Randy Brinkley said. "It improves the probabilities for mission success while providing added flexibility and adaptability for reacting to real-time situations."

In laying out the specific tasks to be completed on each of the spacewalks, officials have determined that changing out the gyros, solar arrays and the Wide Field/Planetary Camera (WF/PC) and installing the Corrective Optics Space Telescope Axial Replacement (COSTAR) are priority objectives during the mission.

"When we looked at accomplishing all of the tasks, highest through lowest priority, and recognizing that the major tasks -- gyros, solar arrays, WF/PC and COSTAR -- would consume most of the time set aside for each spacewalk, five EVAs were deemed appropriate," said Milt Heflin, Lead Flight Director for the mission.

- more -

While the five spacewalks will be unprecedented, the use of two alternating spacewalk teams will alleviate placing more stress on the crew than previous missions requiring two, three or four EVAs.

"We have paid close attention to lessons learned during previous spacewalks and factored these into our timeline estimates for five EVAs," Heflin said. "In planning for all Space Shuttle missions, it is necessary to formulate a work schedule that represents as realistic a timeline as possible to accomplish the mission objectives."

Planning currently calls for at least five water tank training sessions that include support from the Mission Control Center, called joint integrated simulations, lasting between 10 and 36 hours. In addition, many stand alone underwater training "runs" will practice individual tasks in each spacewalk.

Various refinements to the specific tasks on each spacewalk will be made based on actual training experience during the months prior to the mission. Also, lessons learned from other spacewalks leading up to the flight will be valuable in assisting the STS-61 crew in its training techniques.

Endeavour's June flight and Discovery's July mission both will include spacewalks to evaluate some of the unique tools to be used on the HST mission. The evaluations will help in better understanding the differences between the actual weightlessness of space and the ground training in the water tanks at the Johnson Space Center, Houston, and the Marshall Space Flight Center, Huntsville, Ala.

Also, the inflight spacewalking experiences will assist in gaining further insight into the time required for the various tasks and expand the experience levels among the astronaut corps, the flight controllers and trainers.

Designed to be serviced by a Space Shuttle crew, Hubble was built with grapple fixtures and handholds to assist in the capture and repair procedures.

The telescope was launched aboard Discovery in April 1990. At that time the NASA mixed fleet manifest showed the first revisit mission to HST in 1993 to change out science instruments and make any repairs that may have become necessary.

- end -

NASA News

National Aeronautics and
Space Administration

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ISY

For Release

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April 27, 1993

EDITORS NOTE: N93-22

STS-56 CREW POSTFLIGHT PRESS CONFERENCE SCHEDULED FOR TODAY

The STS-56 crew postflight press conference is scheduled for today, Tuesday, April 27, at 4:30 pm EDT, at the Johnson Space Center (JSC), Houston.

Crew members will discuss their experiences aboard Space Shuttle Discovery during the recent mission which landed on April 17 at the Kennedy Space Center, Fla. STS-56 crew members were Kenneth D. Cameron, commander; Stephen S. Oswald, pilot; Michael Foale, Kenneth D. Cockrell and Ellen Ochoa, mission specialists.

News media are invited to monitor the press conference at NASA Headquarters and other centers. The conference will be available at NASA Headquarters, 8th Floor Conference Room, 300 E Street, SW, Washington. The briefing will be carried on NASA Select television, SATCOM F2R, transponder 13, located at 72 degrees west longitude.

-end-

NASA News

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For Release
April 29, 1993

NOTE TO EDITORS: N93-23

STATION REDESIGN ADVISORY COMMITTEE MEETING SCHEDULED

The Advisory Committee on the Redesign of the Space Station, headed by Dr. Charles M. Vest, will hold its next open meeting on Monday, May 3, 1993, at the Crystal Gateway Marriott Arlington ballroom number 3, 1700 Jefferson Davis Highway, Arlington, Va., from 12:30 to 6:00 p.m.

Subjects to be discussed may include requirements; science priorities; options update and comparisons; and international partners' assessments.

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
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For Release

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April 29, 1993

RELEASE: 93-77

TECHNOLOGY TRANSFER CENTER TO WORK WITH SDIO TO AID INDUSTRY

The National Technology Transfer Center (NTTC), Wheeling, W.Va., under an agreement with the Strategic Defense Initiative Organization (SDIO), will assist SDIO in the operation of its Technology Applications Information System and to help identify items which should be included in the technology applications database.

The agreement calls for the NTTC, which is funded by NASA and works in cooperation with other federal agencies, to help the Strategic Defense Initiative Technology Applications Program coordinate the transfer of SDIO-developed technology into the commercial sector.

The NTTC also will identify appropriate public and private technology organizations which may be interested in SDIO-developed technology or innovations and will provide information to these additional organizations.

NASA's Chief of Technology Transfer Programs, Frank Penaranda said "this agreement marks an important step in our efforts to establish the NTTC as a national resource for federal technology transfer."

The NTTC Director, Lee Rivers, said "the affiliation with the Strategic Defense Initiative Office represents a natural partnership. SDIO has produced cutting edge technologies that are ready to be developed into products for the market place. The NTTC can help make those technologies available to U.S. companies."

The SDIO Deputy Director for their technology applications office, Nick Montanarelli, said "we believe the combination of NTTC and SDIO efforts will serve to enhance the NTTC's current and emerging capabilities and will result in a synergism between the two offices. The technology transfer objectives of both organizations will be enhanced.

- end -

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-57

PRESS KIT
JUNE 1993

SPACEHAB / EURECA RETRIEVAL

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For Information on the ESA EURECA Spacecraft and Experiments

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CONTENTS

RELEASE: 93-78

FIRST SPACEHAB FLIGHT HIGHLIGHTS STS-57 SHUTTLE MISSION

The beginning of a new era in the commercial development of space and the retrieval of a European satellite highlight NASA's Shuttle Mission STS-57. The mission, scheduled for early June 1993, also will see Space Shuttle Endeavour and her six-person crew use experiments designed by and for students, operate a payload which may improve crystal growth techniques and demonstrate possbile on-orbit refueling techniques.

A rendezvous with the European Space Agency's European Carrier (EURECA) satellite is scheduled to take place on the fourth day of the mission. The Shuttle's robot arm will be used to grapple the satellite. It then will be lowered into Endeavour's cargo bay and stowed so it can be returned to Earth. The EURECA satellite has been on-orbit collecting data since its deployment during Shuttle Mission STS-46 in July 1992.

On STS-57, NASA will be leasing a privately-developed mid-deck augmentation module known as SPACEHAB. The primary objective is to support the agency's commercial development of space program by providing additional access to crew-tended, mid-deck locker or experiment rack space. This access is necessary to test, demonstrate or evaluate techniques or processes in microgravity.

NASA's secondary objective is to foster the development of space infrastructure which can be marketed by private firms to support commercial microgravity research payloads. In this instance, SPACEHAB, Inc., has the capability of leasing SPACEHAB facility space to other commercial customers on upcoming flights of the module.

The experiments flying inside this first SPACEHAB include investigations ranging from drug improvement, feeding plants, cell splitting, the first soldering experiment in space by American astronauts and high-temperature melting of metals.

Included are 13 commercial development of space experiments in material processing and biotechnology, one NASA biotechnology experiment and five other NASA investigations related to human factors and the Endeavor's environment and a space station environmental control system test.

Three other payloads, the Get Away Special (GAS), the Consortium for Materials Development in Space Complex Autonomous Payload-IV (CONCAP-IV) and the Superfluid On-Orbit Transfer (SHOOT) payload will be carried in Endeavour's cargo bay.

The GAS system, which has flown many times on the Space Shuttle, allows indiviudals and organizations around the world access to space for scientific research. During the STS-57 mission, 10 GAS payloads from the United States, Canada, Japan and Europe will perform a variety of microgravity experiments.

The CONCAP-IV payload is the fourth area of investigation in a series of payloads. It will investigate the growth of nonlinear organic crystals by a novel method of physical vapor transport in the weightlessness of the space environment. Nonlinear optical materials are the key to many optical applications now and in the future with optical computing being a prime example.

The SHOOT payload is designed to develop and demonstrate the technology required to re-supply liquid helium containers in space. Because so little experience exists with cryogen management in microgravity, SHOOT is designed to gather data about how the liquid feeds to pumps, the behavior of the liquid/vapor discriminators and the slosh and cool down of the liquid.

Middeck Experiments

Two experiments which previously have flown aboard the Shuttle will be carried in Endeavour's middeck area. The Fluid Acquisition and Resupply Experiment (FARE), which last flew on Shuttle Mission STS-53 in November 1992, will continue to investigate the fill, refill and expulsion characteristics of simulated propellant tanks. It also will study the behavior of liquid motion in microgravity.

The Air Force Maui Optical System (AMOS) is an electro-optical facility located on the Hawaiian Island of Maui. The primary objectives of AMOS are to use the orbiter during flights over Maui to obtain imagery and/or signature data from the ground-based sensors.

Spacewalk on STS-57

STS-57 crew members David Low and Jeff Wisoff will perform a 4-hour extravehicular activity (EVA) on the fifth day of the flight as a continuation of a series of spacewalks NASA plans to conduct to prepare for construction of the space station.

The spacewalk tests, the first of which was performed on STS-54 in January 1993, are designed to refine training methods for spacewalks, expand the EVA experience levels of astronauts, flight controllers and instructors, and aid in better understanding the differences between true weightlessness and the ground simulations used in training.

In addition, since the Shuttle's remote manipulator system mechanical arm will be aboard Endeavour to retrieve EURECA, the STS-57 spacewalk will assist in refining several procedures being developed to service the Hubble Space Telescope on mission STS-61 in December.

Education

NASA's on-going educational efforts will be represented by two payloads. The Get-Away Special (GAS) #324 - CAN DO experiment is designed to take 1,000 photos of the Earth allowing students to make observations and document global change by comparing the CAN DO photos with matched Skylab photos.

The primary payload of CAN DO, known as GEOCAM, contains four Nikon 35mm cameras equipped with 250 exposure film backs. The GEOCAM system will match closely the larger Skylab film format in both coverage and quality allowing direct examination and comparison of the changes that have occurred to the planet in the last 20 years. The canister also contains 350 small, passive, student experiments.

STS-57 crew members will take on the role of teacher as they educate students from around the world about their mission objectives and what it is like to live and work in space by using the Shuttle Amateur Radio Experiment (SAREX) experiment. Brian Duffy and Janet Voss will operate SAREX. Operating times for school contacts are planned into the crew's activities.

Mission Summary

Leading the six-person STS-57 crew will be Mission Commander Ronald Grabe who will be making his fourth space flight. Pilot for the mission is Brian Duffy, making his second flight. Leading the science team will be Payload Commander David Low who also is designated as Mission Specialist 1 (MS1) and is making his third flight. The three other mission specialists for this flight are Nancy Sherlock (MS2), Jeff Wisoff (MS3) and Janice Voss (MS4), all of whom will be making their first flight.

The mission duration for STS-57 is planned for 6 days, 23 hours, 19 minutes. However, the mission may be extended by 1 day immediately after launch if projections calculated at that time for energy and fuel use during the EURECA rendezvous permit. If for some reason STS-57 remains a 7-day flight, the extravehicular activity scheduled for flight day five would be cancelled. The STS-57 mission will conclude with a landing at Kennedy Space Center's Shuttle Landing Facility.

This will be the fourth flight of Space Shuttle Endeavour and the 56th flight of the the Space Shuttle system.

- end -

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude; frequency 3960.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville, Ala.; Ames-Dryden Flight Research Facility, Edwards, Calif.; Johnson Space Center, Houston and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule is updated daily at noon Eastern time.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a Flight Director or Mission Operations representative and when appropriate, representatives from the science team, will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-57 Quick Look

Launch Date/Site:	June 3, 1993/Kennedy Space Center - Pad 39A
Launch Window:	6:13 p.m. - 7:24 p.m. EDT
Orbiter:	Endeavour (OV-105) - 4th Flight
Orbit/Inclination:	250 nautical miles/28.45 degrees
Mission Duration:	6 days, 23 hours, 19 minutes
Landing Date:	June 10
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites:	Return to Launch Site - KSC, Fla.
	TransAtlantic Abort landing - Banjul, The Gambia
	- Ben Guerir, Morroco
	- Moron, Spain
	Abort Once Around - Edwards AFB, Calif.

Crew:
Ronald Grabe, Commander (CDR)
Brian Duffy, Pilot (PLT)
David Low, Payload Commander/Mission Specialist 1 (MS1)
Nancy Sherlock, Mission Specialist 2 (MS2)
Jeff Wisoff, Mission Specialist 3 (MS3)
Janice Voss, Mission Specialist 4 (MS4)

Cargo Bay Payloads:
EURECA-1R (European Retrievable Carrier - Retrieval)
SPACEHAB (Space Habitation Module)
SHOOT (Super-fluid Helium On-Orbit Transfer)
CONCAP-IV (Consortium for Materials Development in Space Complex Autonomous Payload-IV)
GAS Bridge (Get-Away Special Bridge)

In-Cabin Payloads:
AMOS (Air Force Maui Optical Site)
FARE (Fluid Acquisition and Resupply Experiment)
SAREX-II (Shuttle Amateur Radio Experiment-II)

DTOs/DSOs:

DTO 412:	On-orbit Fuel Cell Shutdown
DTO 623:	Cabin Air Monitoring
DTO 700-2:	Laser Range, Range-Rate Device
DSO 603B:	Orthostatic Function During Entry, Landing and Egress
DSO 604 OI-1:	Visual Vestibular Integration as a Function of Adaptation
DSO 618:	Effects of Intense Exercise During Space Flight on Aerobic Capacity and Orthostatic Function
DSO 624:	Pre-Flight and Post-Flight Measurement of Cardiorespiratory Response
DSO 901:	Documentary Television
DSO 902:	Documentary Motion Picture Photography
DSO 903:	Documentary Still Photography

STS-57 VEHICLE AND PAYLOAD WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Endeavour) empty and 3 Shuttle Main Engines	173,023
Spacehab-1/support hardware	9,628
EURECA (berthed)	9,800
GAS bridge, cans	5,652
SHOOT/support hardware	3,570
FARE	126
SAREX-II	46
Total Vehicle at solid rocket booster Ignition	4,516,091
Orbiter Landing Weight	224,111

STS-57 SUMMARY TIMELINE

NOTE: The STS-57 mission is planned to be 6 days, 23 hours, 19 minutes long. However, it may be extended by 1 day immediately after launch if projections calculated at that time for energy and fuel use during the EURECA rendezvous permit. If STS-57 remains a 6-day (MET) flight, the extravehicular activity scheduled for flight day five would be cancelled. Activities planned for the first four flight days would be unchanged. Flight control system checkout, reaction control system hot-fire and Spacehab deactivation would take place on flight day seven. Entry and landing would be on flight day eight.

The following is a schedule for the extended, 7-day, 23-hour (MET) mission:

Flight Day One
Ascent
OMS-2 (251 n.m. x 169 n.m.)
Spacehab activation
Spacehab operations
NC-1 burn (251 n.m. x 174 n.m.)

Flight Day Two
Remote manipulator system checkout
SHOOT operations
Spacehab operations
NC-2 burn (251 n.m. x 178 n.m.)

Flight Day Three
SHOOT operations
Spacehab operations
NC-3 burn (251 n.m. x 184 n.m.)

Flight Day Four
EURECA retrieval
NSR burn (251 n.m. x 248 n.m.)
NH-4 burn (257 n.m. x 250 n.m.)
TI-burn (259 n.m. x 256 n.m.)
EURECA grapple
EURECA berth
Spacehab operations

Flight Day Five
Extravehicular activity preparations
Extravehicular activity (4 hours)

Flight Day Six
Spacehab operations
FARE operations

Flight Day Seven
Spacehab operations
FARE operations

Flight Day Eight
Spacehab operations
Flight control systems checkout
Reaction control system hot-fire
Spacehab deactivation
Cabin stow

Flight Day Nine
Spacehab deactivation completed
Deorbit preparations
Deorbit burn
Entry
Landing

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

- **Abort-To-Orbit (ATO)** -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

- **Abort-Once-Around (AOA)** -- Earlier main engine shutdown with the capability to allow one orbit around before landing at Edwards Air Force Base, Calif.

- **TransAtlantic Abort Landing (TAL)** -- Loss of one or more main engines midway through powered flight would force a landing at either Banjul, The Gambia; Ben Guerir, Morocco; or Moron, Spain.

- **Return-To-Launch-Site (RTLS)** -- Early shutdown of one or more engines, and without enough energy to reach Banjul, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-57 contingency landing sites are the Kennedy Space Center, Edwards Air Force Base, Banjul, Ben Guerir and Moron.

STS-57 Orbital Events Summary (for 1-day extended mission)

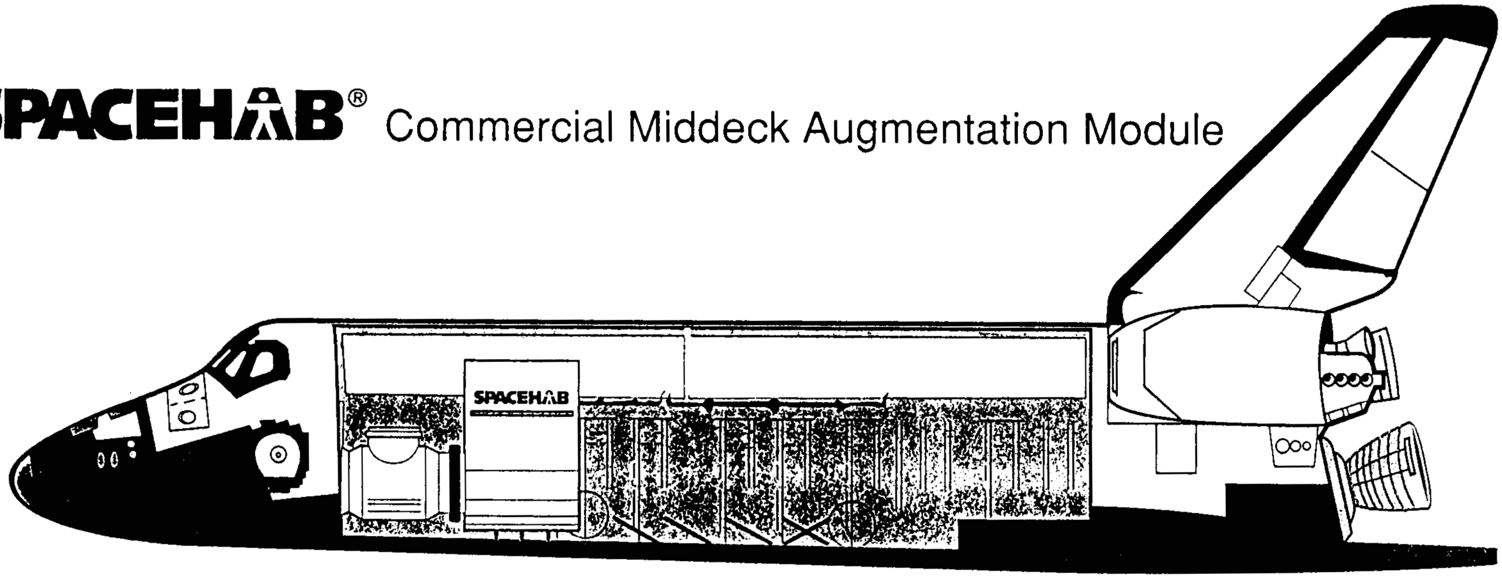
EVENT	START TIME (dd/hh:mm:ss)	VELOCITY CHANGE (feet per second)	ORBIT (n.m.)
OMS-2	00/00:44:00	241 fps	251 x 169
NC-1 (adjusts the rate at which Endeavour is closing on EURECA)	00/05:21:00	8 fps	251 x 174
SH-1 (performed as part of the Super Fluid Helium On-Orbit Transfer experiment)	00/22:18:00	3.4 fps	251 x 176
NPC (aligns Endeavour's orbit directly below EURECA's orbit)	01/03:04:00	6.2 fps	251 x 175
NC-2 (adjusts the rate at which Endeavour is closing on EURECA)	01/04:28:00	4 fps	251 x 178
SH-2 (performed for the SHOOT experiment)	01/19:53:00	3.6 fps	251 x 180
SH-3 (performed as part of the SHOOT experiment)	01/21:26:00	3.6 fps	251 x 182
NC-3 (adjusts the rate at which Endeavour is closing on EURECA)	02/03:36:00	4 fps	251 x 184
NSR (circularizes Endeavour's orbit)	02/19:03:00	109 fps	251 x 248
NH (adjusts the altitude of Endeavour's orbit)	02/21:27:00	15 fps	257 x 250
NC-4 (adjusts the rate at which Endeavour is closing on EURECA)	02/21:27:00	8.6 fps	258 x 255
TI (begins Endeavour's proximity operations with EURECA)	03/00:35:00	3.1 fps	258 x 256
GRAPPLE	03/02:50:00		259 x 256
DEORBIT	07/21:36:00	414 fps	
LANDING	07/23/19:00		

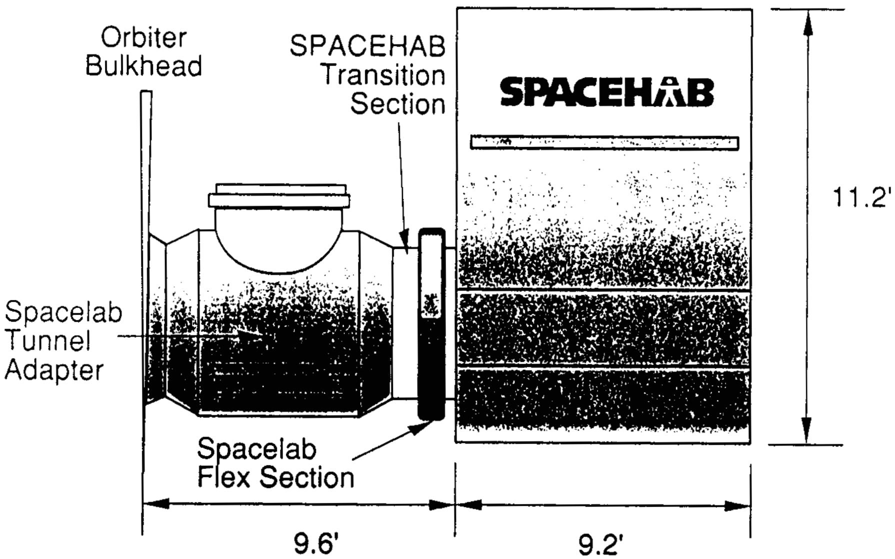
NOTE: Engine firings are likely to change slightly after launch as they are recalculated by flight controllers. In addition, some of the smaller firings may be deleted altogether if navigation information during the rendezvous allows. However, the time frame and other information regarding the larger burns is unlikely to change dramatically.

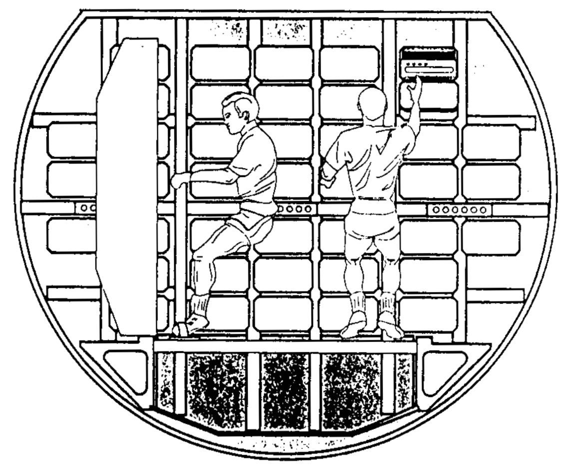
STS-57 CREW RESPONSIBILITIES

TASK/PAYLOAD	PRIMARY	BACKUP
EURECA-RMS	Low	Sherlock
EURECA systems	Sherlock	Duffy
EURECA rendezvous	Grabe	Duffy, Wisoff
EVA	Low, Wisoff	N/A
EVA-RMS	Sherlock	Voss
Spacehab systems	Low	Voss
SHOOT	Voss	Wisoff
FARE	Wisoff	Duffy
GBA	Sherlock	Grabe
SAREX	Duffy	Voss
SPACEHAB experiments:		
ASPECS	Wisoff	Sherlock
BPL	Sherlock	Wisoff
CR/IM-VDA	Low	Voss
HFA: EPROC	Voss	Sherlock
HFA: Light, sound	Grabe	Duffy
HFA: Trans	Sherlock	Grabe
NBP	Duffy	Grabe
PSE	Grabe	Voss
SCG	Voss	Low
TES-COS	Voss	Grabe
APCF	Voss	Low
ASC-2	Sherlock	Duffy
CGBA	Wisoff	Voss, Low
CPDS	Voss	Low
3DMA	Voss	Low
ECLIPSE-HAB	Voss	Low
EFE	Low	Sherlock
GPPM	Voss	Low
IPMP	Grabe	
LEMZ-1	Voss	Wisoff
ORSEP	Voss	Low
SAMS	Voss	Low
ZCG	Voss	Low

SPACEHAB® Commercial Middeck Augmentation Module







SPACEHAB-01

Why The Need For SPACEHAB?

During the last decade, the commercial development of space became one of NASA's primary objectives, as directed by legislation and national policy. Through the many facets of its commercial development of space program, NASA has developed and maintains a high level of commitment to this objective. To that end, NASA has actively invested in the continued technological leadership of the United States and her future economic growth through the direct promotion and support of private sector space-related activities.

As a result of NASA's objective, in the late 1980's, its commercial development of space program identified a significant number of payloads to be flown to further program objectives. To viably sustain this program, the Office of Commercial Programs -- now the Office of Advanced Concepts and Technology (OACT) -- had to provide a level of flight activity necessary to support the various payload requirements.

In September 1989, the office conducted an analysis which revealed that planned Space Shuttle flight activity would not meet its needs for middeck-class accommodations. Mission experience has clearly demonstrated that the orbiter middeck is a very cost-effective area to conduct "crew-tended" scientific and commercial microgravity research. However, the size and number of experiments that can be accommodated in the middeck are severely limited and have conflicting requirements from Shuttle operations and other NASA programs.

To provide the necessary support for commercial development of space payloads, the Commercial Middeck Augmentation Module (CMAM) procurement was initiated in February 1990, through NASA's Johnson Space Center (JSC). Consequently, in November 1990, NASA awarded a 5-year contract to SPACEHAB, Inc., of Arlington, Va., for the lease of their pressurized modules, the SPACEHAB Space Research Laboratories. These laboratories provide additional space for "crew-tended" payloads as an extension of the Shuttle orbiter middeck into the Shuttle cargo bay.

This 5-year lease arrangement will cover several Shuttle flights and requires SPACEHAB, Inc., to provide for the physical and operational integration of the SPACEHAB Space Research Laboratories in the Space Shuttle orbiters, including experiments and integration services, such as safety documentation and crew training.

NASA's primary objective for leasing the SPACEHAB Space Research Laboratory is to support the agency's commercial development of space program by providing the access to space. This access is necessary to test, demonstrate or evaluate techniques or processes in the environment of space and thereby reduce risks to a more feasible level.

NASA's secondary objective is to foster the development of space infrastructure which can be marketed by private firms to support commercial microgravity research payloads. NASA is only partially using the SPACEHAB Space Research Laboratory multi-flight capacity, therefore, SPACEHAB, Inc., is marketing the additional portion to other commercial users. It is expected that significant commercial demand will result from the successful demonstration of SPACEHAB capabilities on this first flight.

SPACEHAB Accommodations

The SPACEHAB Space Research Laboratory is located in the forward end of the Shuttle orbiter cargo bay and is accessed from the orbiter middeck through a tunnel adapter connected to the airlock. SPACEHAB weighs 9,628 pounds, is 9.2 feet long, 11.2 feet high and 13.5 feet in diameter. It increases pressurized experiment space in the Shuttle orbiter by 1100 cubic feet, quadrupling the working and storage volume available. Environmental control of the laboratory's interior maintains ambient temperatures between 65 and 80 degrees Fahrenheit.

The laboratory has a total payload capacity of 3000 pounds and in addition to facilitating crew access, provides experiments with services such as power, temperature control and command/data functions. Other services, such as late access/early retrieval, also are available.

The SPACEHAB Space Research Laboratory can provide various physical accommodations to users based on size, weight and other requirements. Experiments are commonly integrated into the laboratory in Shuttle middeck-type lockers or SPACEHAB racks. The laboratory can accommodate up to 61 lockers, with each locker providing a maximum capacity of 60 pounds and 2.0 cubic feet of volume.

The laboratory also can accommodate up to two SPACEHAB racks, either of which can be a "double-rack" or "single-rack" configuration, but each rack used reduces the number of usable locker locations by 10 lockers. A "double-rack" provides a maximum capacity of 1250 pounds and 45 cubic feet of volume, whereas a "single-rack" provides half of that capacity. The "double-rack" is similar in size and design to the racks planned for use in the space station.

The use of lockers or racks is not essential for integration into the SPACEHAB Space Research Laboratory. Payloads also can be accommodated by directly mounting them on the laboratory.

SPACEHAB Operations Philosophy

By its very nature, the Office of Advanced Concepts and Technology (OACT) flight programs assume a certain level of risk in order to approach the payloads from the commercial standpoint, including payload development costs incurred by industry partners. Each of the investigators is aware of and accepts a self-established level of risk for mission success. However, crew and orbiter safety requirements are always fully met.

The preparations for the flight of SPACEHAB-1 have included the development of a number of backup and contingency operations for each payload appropriate to that payload's relative design simplicity. These backup procedures include scenarios which might possibly affect crew or orbiter safety and each payload has procedures associated with it and which the crew has been trained in which will deactivate and/or safe the payload.

The SPACEHAB-01 Payload Complement

From improving drugs to feeding plants, from cell splitting to intergalactic particles, from the first soldering experiment in space by American astronauts to high-temperature melting of metals, the SPACEHAB-01 payloads represent a wide range of space experimentation.

Included are 13 commercial development of space experiments in material processing and biotechnology, 12 of which are sponsored by NASA Centers for the Commercial Development of Space (CCDS) and one by the NASA Langley Research Center, Hampton, Va. There is one NASA biotechnology experiment and five other NASA investigations related to human factors and the Endeavour's environment. Finally, there is a space station environmental control system test and as supporting hardware, two accelerometers -- one from a CCDS and one from the NASA Lewis Research Center, Cleveland.

Each of the 13 commercial development of space payloads has been screened by OACT to review the viability of the commercial aspects of the proposed activity as well as the technical soundness. Some of the SPACEHAB-01 CCDS payloads have flown on the Shuttle before, with the SPACEHAB-01 flight representing the continuation of industry-driven research toward a new or improved commercial product or process. Many of the CCDS payloads, including the CCDS-sponsored accelerometer, have participated in the NASA OACT Consort series of suborbital sounding rocket flights to test hardware operation and gain flight worthiness.

The five investigations sponsored by the NASA Johnson Space Center, involving biotechnology and human factors, were included to assure full utilization of the first flight of the SPACEHAB Space Research Facility and have been reviewed for their support to commercial objectives. These experiments include equipment testing for future uses on the space station such as the first-ever American soldering experiment performed in space.

Also on-board the SPACEHAB Space Research Laboratory is an investigation sponsored by the NASA space station office in Reston, Va., on closed systems to improve water recycling in the future space station environment.

The experiments, housed in the SPACEHAB Space Research Laboratory on this its maiden voyage to space, represent a tremendous effort by government and industry to stretch the possibilities of space as the final frontier -- an effort focussed on fostering economic growth.

NASA Centers for the Commercial Development of Space

The CCDS program is the cornerstone of NASA's commercial development of space activities, generating 13 of the 21 total flight hardware packages on this SPACEHAB Space Research Laboratory. NASA's nationwide CCDS network represents a unique example of how government, industry and academic institutions can create partnerships which combine resources and talents to strengthen America's industrial competitiveness.

The CCDSs are designed to increase private sector investment and interest in commercial space-related activities, while encouraging U.S. economic leadership and stimulating advances in promising areas of research and development. The CCDSs are based at universities and research institutions across the country and benefit from links with each other and with NASA field centers.

Since 1985, OACT has issued four proposal solicitations in various areas of promising space-related commercial research and development. From the solicitations, 17 centers have been established in eight industry-driven, space-based, high-technology research areas such as materials processing, biotechnology, remote sensing, communications, automation and robotics, space propulsion, space structures and space power.

NASA OACT provides annual funding of up to $1 million to each center, with additional funding to those centers to cover specific programs or flight activities, as appropriate. NASA offers the CCDSs its scientific and technical expertise through NASA field centers, opportunities for cooperative activities and other forms of continuing assistance. A key facet of the CCDSs is the additional financial and in-kind contributions from industry affiliates, state and other government agencies, which, on the average, exceed the NASA funding level.

Through creative and enterprising partnerships with industry, the CCDS program helps move emerging technologies from the laboratory to the marketplace with speed and efficiency. The accomplishments of CCDS participants include significant advances in a number of scientific fields and hundreds of Earth- and space-based applications.

As an incubator for future commercial space industries, the CCDS program, since its inception, has facilitated a number of new commercial space ventures and supported a wide range of ongoing efforts. The CCDS program continues to be the key facilitator for U.S. industry involvement in commercial development of space activities, encouraging and supporting new and ongoing space-related ventures, as well as spawning research and development advancements that promise enormous social and economic benefits for all.

1993 - The Year of Commercial Space

Since late 1988, 37 commercial development of space payloads have successfully flown on the Space Shuttle including the outstanding performance of four payloads as part of the first United States Microgravity Laboratory (USML-1) mission in June 1992. Additionally, 27 commercial space research payloads have flown on several suborbital sounding rockets.

During 1993, 56 research payloads are planned, including those on the first two flights of the SPACEHAB Space Research Laboratory and the first flight of the COMmercial Experiment Transporter (COMET). The same period also will mark the first flight of a commercial free-flyer research facility, the Wake Shield

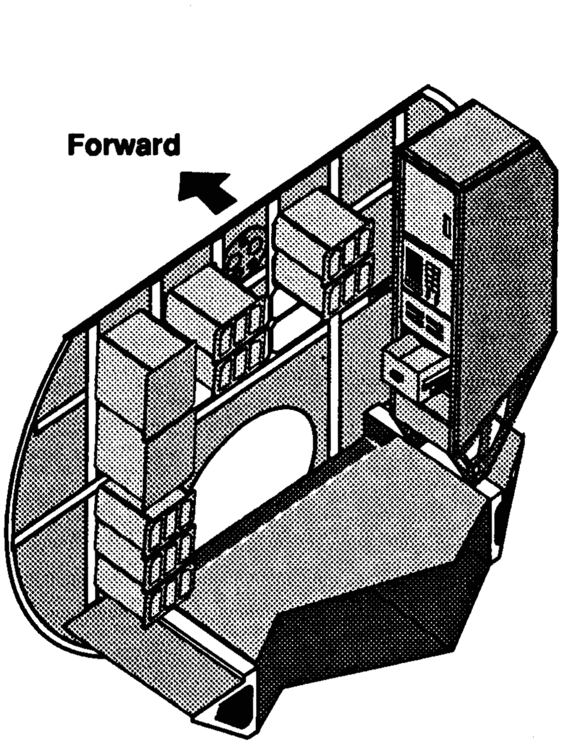
Facility, as well as several Space Shuttle secondary payloads and the launch of the Advanced Communications Technology Satellite (ACTS). Another suborbital sounding rocket flight in the Consort series already has been successfully accomplished with nine payloads on-board in February 1993.

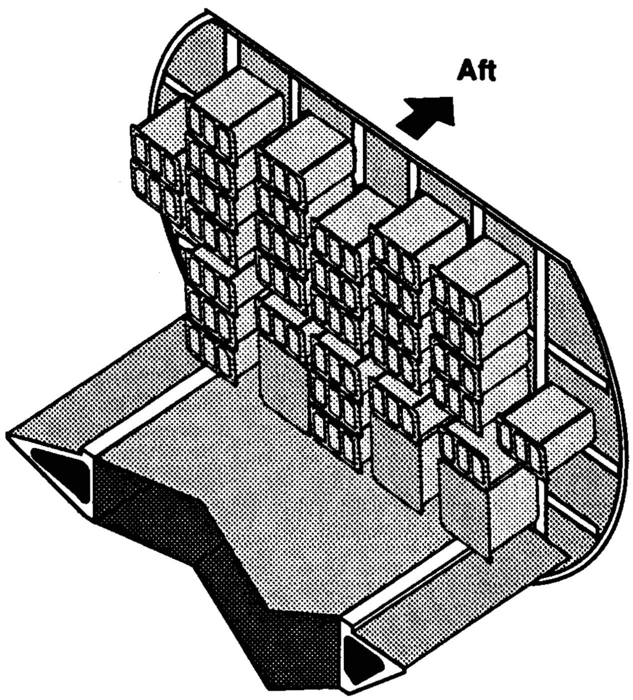
Two attributes of these innovative programs are the relatively small amount of federal funds expended and the low number of NASA personnel involved. The associated development of additional spaceflight services has spurred commercial space infrastructure capabilities while reducing a considerable backlog and reliance upon the Space Shuttle.

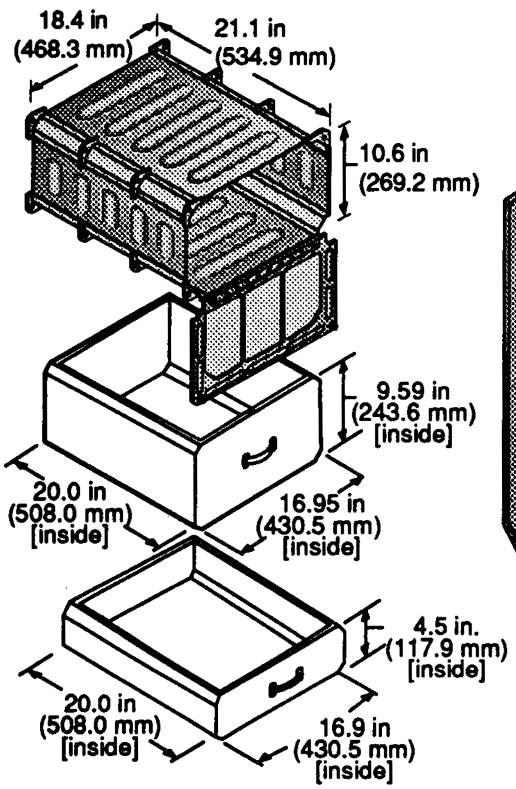
In citing 1993 as The Year of Commercial Space, Greg Reck, Acting Associate Administrator for the OACT said, "The success of the Centers for the Commercial Development of Space and their many industry and academic affiliates should be recognized."

"They are entrepreneurial visionaries, formulating and implementing an industry-driven program to identify and capitalize on the real possibilities in space-related commerce," Reck said. "The bright outlook for 1993 will stand as a landmark for the realization of the commercial potentials of space and as a benchmark for the development of the space frontier. The ultimate benefits for all of us will be more than we can now imagine."

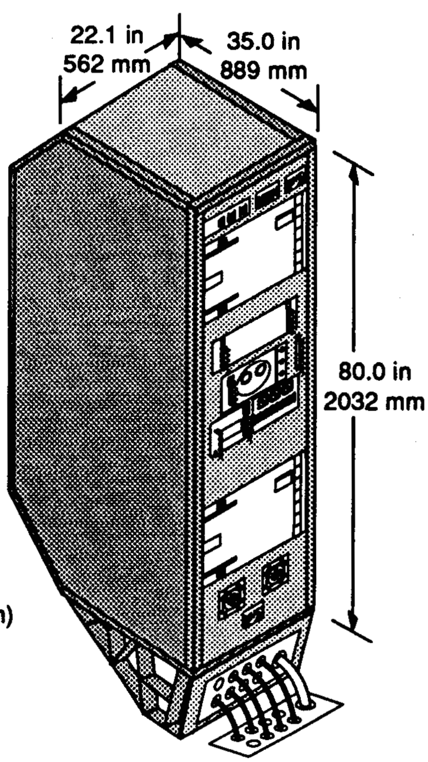
SPACEHAB® Typical Interior Configuration



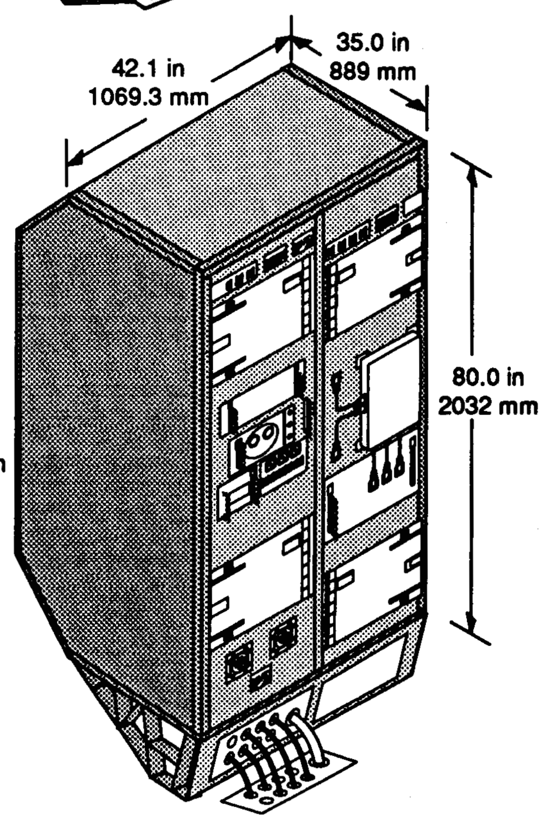




Locker & Trays

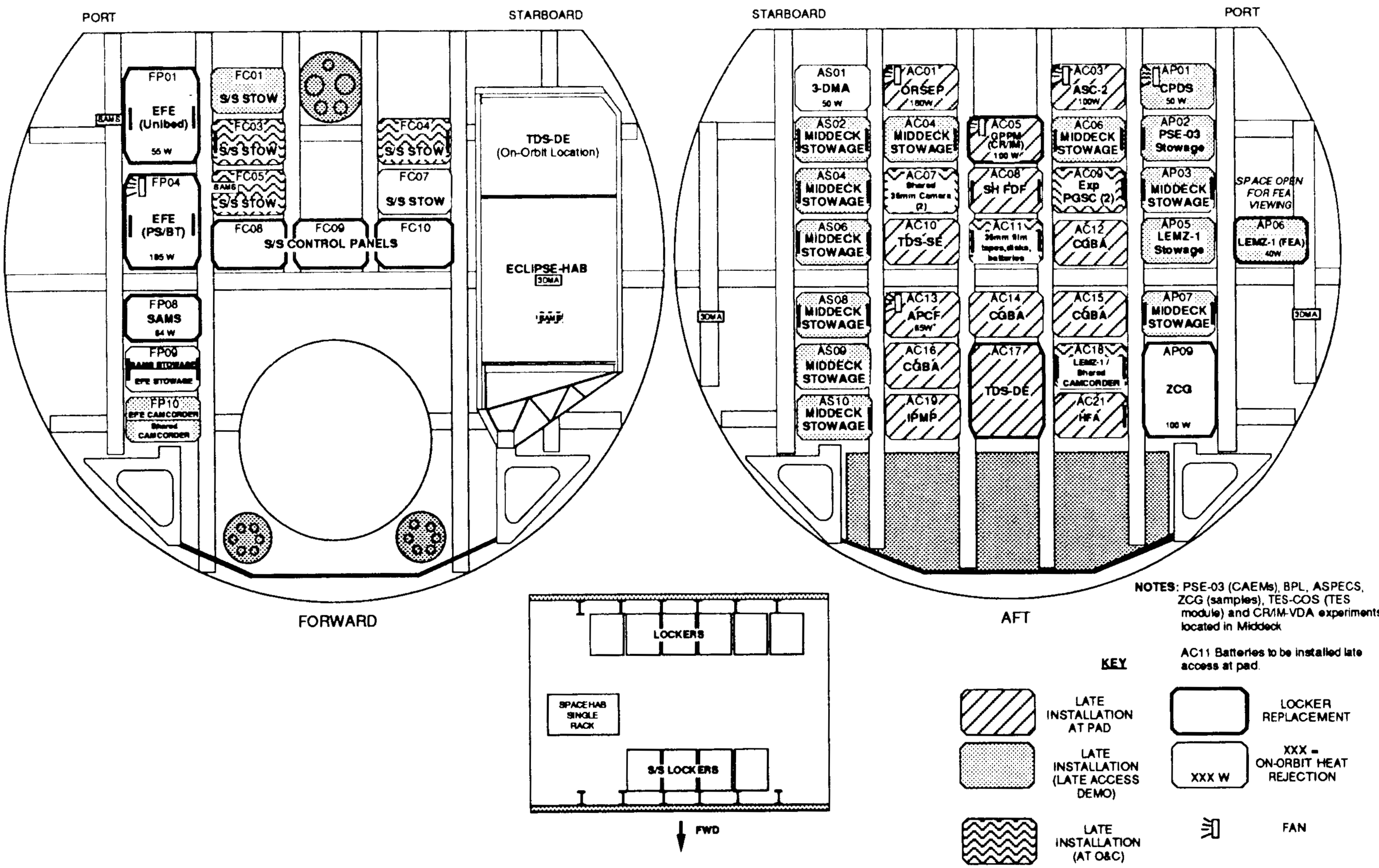


Single Rack



Double Rack

SPACEHAB's Space Research Laboratory Mission One Layout Configuration



SPACEHAB-01 Commercial Material Science Experiments

Equipment for Controlled Liquid Phase Sintering Experiments

The CMDS, based at the University of Alabama in Huntsville (UAH), has developed the Equipment for Controlled Liquid Phase Sintering Experiments (ECLiPSE), making its first long-duration space flight on STS-57 in the SPACEHAB. The UAH CMDS is a NASA Center for the Commercial Development of Space (CCDS).

The ECLiPSE experiment investigates the liquid phase sintering (LPS) of metallic systems. Sintering is a process by which metallic powders are consolidated into a metal at temperatures only 50-75 percent of that required to melt all of the constituent phases. In LPS, a liquid coexists with the solid, which can produce sedimentation, thus producing a material that lacks homogeneity and dimensional stability. To control sedimentation effects, manufacturers limit the volume of the liquid. The ECLiPSE experiment examines metallic composites at or above the liquid volume limit to more fully understand the processes taking place and to produce materials that are dimensionally stable and homogeneous in the absence of gravity.

The ECLiPSE project is focused on composites of hard metals in a tough metal matrix. This composite will have the excellent wearing properties of the hard material and the strength of the tough material. Applications of such a composite include stronger, lighter, more durable metals for bearings, cutting tools, electrical brushes, contact points and irregularly shaped mechanical parts for high stress environments.

Kennametal, Inc., is an industry partner of the UAH CMDS participating in the ECLiPSE experiment and has immediate applications for materials improvements in the ceramic composites tested. Kennametal is developing stronger, more durable tool bits. Wyle Laboratories also is an industrial partner with the UAH CMDS on the ECLiPSE experiment.

This Shuttle flight of the ECLiPSE payload is building on the experience of other ECLiPSE flights on suborbital sounding rockets. Suborbital flights have provided only 1-3 minutes of sample processing time, and now the longer flight durations possible on the Shuttle are required. Because the hardware was originally designed to fly in suborbital rockets, it is very automated, requiring little crew interaction. The UAH CMDS is planning more suborbital rocket flight testing and future SPACEHAB missions of the ECLiPSE experiment as part of its sintered and alloyed materials project.

Principal Investigator for ECLiPSE is Dr. James E. Smith, Jr., Associate Professor and Head, Department of Chemical and Materials Engineering, University of Alabama in Huntsville.

Gas Permeable Polymeric Materials

The Gas Permeable Polymeric Materials (GPPM) payload is sponsored by the Instrument Research Division, NASA Langley Research Center (LaRC), through a joint NASA/industry program initiated in 1987 with OACT. STS-57 and at least one future space flight of this polymer study program will determine if certain types of polymers made in microgravity are very different from the same polymers made simultaneously on the ground.

Plastic materials, which are made of very large molecules called "polymers," are used in everyday life in many ways. Some polymers prevent gases, such as oxygen, from passing through. These polymers are used in keeping foods fresh for long periods of time in a refrigerator or freezer. Other polymers allow one or more gases to pass through. These polymers, called gas permeable polymeric materials, also have many uses.

The Gas Permeable Polymeric Materials (GPPM) flight experiment will determine if certain types of polymers made in low gravity while the Space Shuttle is in orbit are very different from the same polymers made at the same time on the ground.

Gas permeable polymeric materials are being developed for many uses. These include special contact lenses for long-term wear and for use by pilots and astronauts; medical applications such as dialysis and blood gas monitoring; control of fermentation and other industrial processes and commercial production of pure gases.

Another promising use is the development of sensors that will measure any gas in the air in very small amounts. In this device, a very thin layer of the polymer is coated on a sensor. The polymer allows only the gas which is to be measured to pass through it. The sensor then measures the amount of gas that is present. These devices will be used in monitoring indoor air quality and in detecting dangerous gases, such as carbon monoxide.

Gravity may affect many properties of the polymer while it is being made. As early as 1984, it was suggested that these effects may be eliminated or at least reduced if the polymer was made in the low gravity of space flight. A better understanding of how these polymers are formed also can be learned under these conditions. These experiments must be carried out on the Space Shuttle with the assistance of the astronaut crew because the rates at which the polymers are formed are very slow. If these polymers are very different as expected, many new and improved products will result from them.

The gas permeable polymeric materials being studied by NASA are useful to the contact lens and industrial gas industries. In addition, the polymers being developed by these industries are of special interest to NASA.

A joint NASA and industry program to study polymers made in low gravity was approved in January 1987 by the NASA Office of Commercial Programs, now the OACT. The Instrument Research Division at the NASA LaRC is the NASA organization performing the study. A leading manufacturer of polymers for contact lenses, the Paragon Optical Co., of Phoenix, Ariz., is the Industrial Guest Investigator.

The GPPM flight experiment will be carried out in a sealed aluminum container called the Polymerization Module, developed by the Systems Engineering Division at LaRC. The flight Polymerization Module will be installed in a Commercial Refrigerator/Incubator Module (CRIM) developed by Space Industries Inc., Webster, Texas. The CRIM, which is a small refrigerator and oven in a single unit, can maintain temperatures over a range of 4 degrees C to 40 degrees C for indefinite periods.

Twenty-eight polymer materials will be placed into the flight Polymerization Module and CRIM in an experiment preparation room at the SPACEHAB Payload Processing Facility near the NASA Kennedy Space Center. Identical materials will be placed in another Polymerization Module and laboratory CRIM. The materials will be kept at 4 degrees C until the start of the experiment.

The Polymerization Module and CRIM will be used on future missions in the SPACEHAB Space Research Laboratory or in a middeck locker on the Shuttle. At least one more mission is being planned by NASA and Paragon researchers. This mission also may provide an opportunity for additional industrial guest investigators to perform an experiment.

Investigations into Polymer Membrane Processing

The Investigations into Polymer Membrane Processing (IPMP) payload will make its eighth Space Shuttle flight for the Ohio-based Battelle Advanced Materials Center, a NASA CCDS.

The objective of IPMP is to investigate the physical and chemical processes that occur during the formation of polymer membranes in microgravity, such that the improved knowledge base can be applied to commercial membrane processing techniques. The STS-57 mission will provide additional data on the polymer precipitation process to the knowledge base being developed by Battelle and its industrial partners.

Polymer membranes are porous films which have numerous industrial applications in separation and filtration devices for pollution control, food, chemical and drug purification, and kidney dialysis. The largest potential market may be the environmental sector. Space-based polymer membrane experiments and resulting product improvements could play an important role in pollution control and may serve to significantly reduce the growing problem of dangerous gas emissions in the environment. Amoco Chemical Co., Du Pont and Bend Industries, Inc., have contributed to this project due to the impact it may have on gas separation technology.

A two-step process is used frequently to make polymer membranes. A sample mixture of polymer and solvents is applied to a casting surface. The first step is the evaporation of solvents from the mixture. In the second step, the remaining sample is immersed in a fluid bath (typically water) to precipitate the membrane, form the solution and complete the process.

Results from IPMP's previous seven Shuttle and two sounding rocket flights indicate that polymers grown in space do show consistently different material properties than those produced on Earth. The latest flights have produced polymers that demonstrate the gravitational influence on both the size and distribution of the pores, which is a determining factor in the ability of the commercial sector to use polymers for filtration and separation processes.

The results and knowledge gained from all of the IPMP commercially-applied research flights are being analyzed for potential process-enhancing applications in existing industrial processing plants. Through the dissemination of this information, it is expected there will be increased interest on the part of U.S. materials, chemical and environmental companies to grow polymers and other materials in space on a commercial basis.

IPMP Principal Investigator is Dr. Vince McGinniss, Battelle Advanced Materials Center, Columbus, Ohio. IPMP Program Manager is Lisa McCauley, also of Battelle.

Liquid Encapsulated Melt Zone

The Liquid Encapsulated Melt Zone (LEMZ) experiment is sponsored by the Consortium for Commercial Crystal Growth based at Clarkson University, Potsdam, N.Y., a NASA CCDS. The LEMZ payload is developed by the University of Florida, Gainesville, an academic affiliate of the consortium.

LEMZ is the first experiment in a series of activities to determine the feasibility of commercial, space-based production of materials for applications in the computer, optics and sensor/detector industries. These materials are needed for the next generation of high speed optoelectronic digital circuits, optoelectronic devices and transportation systems. Researchers at the University of Florida have produced small gallium arsenide single crystals encapsulated in molten boron oxide using LEMZ in ground-based experiments.

One of the major thrust areas in materials science is the growth of single crystals with improved homogeneity (uniform parts), purity and structural perfection. However, single crystals grown on Earth have many flaws and impurities because they are in contact with a container. The naturally occurring low gravity conditions of space flight allow large crystals to be grown without touching a container -- a process called floating zone crystal growth. Floating zone crystal growth is expected to result in large single crystals with purity, compositional homogeneity and structural perfection unattainable on the ground.

The hardware used in the LEMZ experiment is the Fluid Experiment Apparatus (FEA) constructed by an industrial partner of the Consortium for Commercial Crystal Growth, Rockwell International. In orbit, several indium bismuth rods will be melted in the FEA. Indium bismuth is a low-melting-temperature compound being used on STS-57 to test the value of liquid encapsulation. Other materials of greater commercial interest will be used on future flights of LEMZ.

The Consortium for Commercial Crystal Growth is teaming with Rockwell International, the University of Florida, McDonnell Douglas and the State of Florida Technology Research and Development Authority (TRDA) on the LEMZ payload. The LEMZ program is part of the consortium's goal to produce high quality single crystals of semiconductors, complex oxides, non-linear optical materials and sensor/detector crystals.

Principal Investigator for LEMZ is Professor Reza Abbaschian, Chairman and Professor, Materials Science and Engineering Department, University of Florida at Gainesville.

Support of Crystal Growth Experiment

The Battelle Advanced Materials Center, a NASA CCDS based in Columbus, Ohio, is sponsoring the Support of Crystal Growth (SCG) Experiment on STS-57.

This experiment is a successor to one conducted in the Spacelab glovebox flown on the first United States Microgravity Laboratory (USML-1) mission in July 1992. SCG supports the Zeolite Crystal Growth (ZCG) experiment also flying in the SPACEHAB Space Research Laboratory in that it provides the invaluable information required to establish the ZCG autoclave mixing protocol so that the resulting crystal growth is optimized. To do this, SCG will assist the crew member and principal investigator in determining how the solutions should be mixed for each of several solution combinations and mixer configurations.

Ground-based and flight research has shown that mixing of the zeolite precursor solutions is critical to producing high quality crystals. Nuclear magnetic resonance imaging studies, KC-135 flights and analysis of the USML-1 results demonstrate the need to optimize the mixing process (uniform mixing while minimizing shear). Determining the proper amount of mixing remains an empirical science and therefore, must utilize crew observation and judgement which requires extensive training and experience.

SCG consists of 12 transparent "autoclaves," comparable to the solution containment portion of the ZCG autoclaves, and a battery-powered screwdriver to activate the mixing process. The "autoclaves" are transparent to facilitate on-board observation by a crew member. Throughout the activation process, a crew member will observe the progression and condition of the mixing of the two solutions. The crew member will downlink video of each activation/mixing and consult with the principal investigator regarding application to the ZCG autoclave activation. This experiment is critical to the success of the ZCG experiment and thus, to the success of the Battelle CCDS zeolite program as a whole.

The Principal Investigator is Dr. Al Sacco, Jr., Worcester Polytechnic Institute, Worcester, Mass. Lisa A. McCauley, Battelle Advanced Materials Center, is the flight program manager.

Zeolite Crystal Growth

STS-57 will be the second Shuttle flight of the Zeolite Crystal Growth (ZCG) payload, developed by the Battelle Advanced Materials Center, Columbus, Ohio, a NASA CCDS. The ZCG experiment flew on the first United States Microgravity Laboratory (USML-1) Shuttle mission (July 1992) and the results appear very positive, and all mission objectives were accomplished.

Zeolite crystals are complex arrangements of silica and alumina which occur both naturally and synthetically. An open, three-dimensional, crystalline structure enables the crystals to selectively absorb elements or compounds. As a result, the crystals are highly useful as catalysts, molecular sieves, absorbents and ion exchange materials.

Zeolites are used for purification and catalytic purposes. As a purifier, zeolites work as molecular-scale sieves to remove contaminants from solutions. If improved zeolites were used in kidney dialysis as a purifier, the time needed to complete dialysis could be significantly reduced. Zeolites also could help in removing impurities in blood molecules, which would be helpful in blood transfusions. As catalysts, zeolites aid in making industrial processes more efficient. The catalytic procedure used to process crude oil into gasoline could benefit from improved zeolites, potentially increasing the yield of gasoline, thus reducing U.S. dependence on foreign oil sources. Amoco Chemical Co. and Du Pont are Battelle's industrial affiliates on this flight of ZCG.

Ultimately, space-produced zeolite crystals are expected to be larger and of higher quality than their ground-produced counterparts, providing tremendous industrial potential for such crystals. The zeolites produced in microgravity are considered high value-added products and will be scaled up to production quantities using the space station and recoverable orbital systems launched by expendable launch vehicles.

The nucleus of the experiment will consist of 38 autoclaves, each containing two solutions in separate chambers and a screw-activated mixing assembly. To activate the experiment, a crew member will operate the screw assembly with a battery-powered screwdriver, which mixes the two zeolite precursor solutions. By repeating this process several times, proper mixing of the two solutions can be obtained (several different mixing devices are to be used on this mission). Results from the Support to Crystal Growth experiment, also flying in the SPACEHAB Space Research Laboratory, will be used to determine the appropriate mixing protocol for each autoclave.

Principal Investigator for ZCG is Dr. Albert Sacco, Jr., Worcester Polytechnic Institute, Worcester, Mass. ZCG Program Manager is Lisa McCauley, Battelle Advanced Materials Center.

SPACEHAB-01 Commercial Life Science Experiments

ASTROCULTURE™

The ASTROCULTURE™ payload is sponsored by the Wisconsin Center for Space Automation and Robotics (WCSAR), a NASA CCDS located at the University of Wisconsin, Madison.

Currently, no satisfactory plant growth unit is available to support long-term plant growth in space. Increases in the duration of space missions, including stays on the space station, have made it necessary to develop plant growth technology that could minimize the cost of life support while in space. Plants can reduce costs of providing food, oxygen and pure water and also lower costs of removing carbon dioxide in human space habitats.

Before plants can be grown in the ASTROCULTURE™ unit, however, a series of experiments are being conducted on the Space Shuttle to evaluate the critical subsystems essential for the space-based applications which also will have tremendous uses on Earth, such as improved dehumidification/humidification units, water-efficient irrigation systems and energy-efficient lighting systems for plant growth.

Results from the flight of the first ASTROCULTURE™ experiment on STS-50, the flight of the first United States Microgravity Laboratory (USML-1) in July 1992, indicate that the experiment successfully achieved all of its goals, and experiment results are expected to provide new information dealing with the performance of water and nutrient delivery in space. ASTROCULTURE™ has been approved for four more Shuttle flights.

The ASTROCULTURE™ unit consists of a covered cavity with two growth chambers containing inert material that serves as the root matrix; a water supply system consisting of a porous stainless steel tube embedded into the matrix, a water reservoir, a pump and appropriate valves for controlling the pressure flow of water through the stainless steel tube; a water recovery system consisting of the same components as the water supply system; and a microprocessor system for control and data acquisition functions. The flight hardware for this mission is self-contained in a SPACEHAB locker and weighs approximately 50 pounds.

This flight of ASTROCULTURE™ will evaluate the performance of other important aspects of the water and nutrient delivery system not studied during the first space experiment. In addition, the STS-57 experiment will provide information on the performance of a light emitting diode (LED) lighting system during an extended period of microgravity. A preliminary evaluation of the LED system was made on the Consort-5 sounding rocket flight in November 1992.

In orbit, the water supply and recovery systems will be activated to initiate circulation of a nutrient solution through the porous tubes. Subsequently, the solution will move through the wall of each porous tube into the matrix by capillary forces. In the matrix, the small pores will be filled with the solution and the large pores with air, thereby providing a non-saturated state. The recovery system will operate at several pressure levels to determine the rate at which the solution will move through the matrix and the capacity of the supply system to provide the solution to the matrix.

The amount of solution transferred from the supply reservoir to the recovery reservoir will be monitored, and data collected by the computer will indicate the supply system's overall capacity for replacing water and nutrients removed by plants growing in microgravity.

The current industry affiliates on ASTROCULTURE™ include Automated Agriculture Assoc., Inc., Dodgeville, Wisc.; Biotronics Technologies, Inc., Waukesha, Wisc.; Quantum Devices, Inc., Barveveld, Wisc.; and Orbital Technologies Corpo., Madison, Wisc. Principal Investigator is Dr. Raymond J. Bula, WCSAR.

BioServe Pilot Laboratory

The BioServe Pilot Laboratory (BPL) is sponsored by BioServe Space Technologies, a NASA CCDS based at the University of Colorado in Boulder.

The BPL will play an important role in providing the commercial and scientific communities affordable access to space for material and life sciences research. The main focus of the project is to provide a "first step" opportunity to companies interested in exploring materials processing and life science experiments in space. The notion behind the project is to allow industry a mechanism for entry level "proof of concept" flights. Thus, the BPL is a crucial screening device for more complex, targeted space research and development activities.

The BPL payload will support investigations in a wide variety of life sciences areas with primary emphasis on cellular studies. For STS-57, two series of investigations will be carried out on bacterial products and processes.

One investigation series examines *Rhizobium trifolii* behavior in microgravity. Rhizobia are special bacteria that form an intimate and advantageous, or symbiotic, relationship with plants. The bacteria infect the plants early in seedling development to form nodules on the plant roots. The bacteria in these nodules derive nutritional support from the plant while in turn providing the plant with nitrogen fixed from the air. Plants that form such relationships with rhizobia are called legumes and include alfalfa, clover and soybean. Such plants do not require synthetic fertilizers to grow. In contrast, many important crop plants such as wheat and corn are dependent on synthetic fertilizers since they do not form symbiotic relationships with rhizobia.

The experimental system employing *Rhizobium trifolii* is a model that can be used to better understand the multi-step process associated with rhizobia infection of legumes. Once understood, it may become possible to manipulate the process to cause infection of other crop plants. The potential savings in fertilizer production would be tremendous.

One of the commercial goals of the BioServe center is to determine whether microgravity might be exploited as a tool for rhizobial infection of significant crop plants. This BPL investigation, along with complimentary investigations in BioServe's Commercial Generic Bioprocessing Apparatus (CGBA) also flying in the SPACEHAB Space Research Laboratory, should provide the data needed to address this goal.

Another series of investigations being flown in the BPL concerns the bacteria *E. Coli*. These bacteria are normally found in the gastrointestinal tracts of mammals, including humans. *E. Coli* have been well studied as a model system for bacterial infection and population dynamics and in genetics research. With regard to commercial application, the genetic material in *E. Coli* has been manipulated to produce bacteria capable of secreting important pharmaceutical products. These bacteria also serve as a model for bacteria used in waste treatment and water reclamation.

For STS-57, these bacteria are being studied to determine changes in growth and behavior that occur as a consequence of exposure to microgravity. The commercial objectives for this investigation include understanding and controlling bacterial infection in closed environments, exploiting bacteria and other micro-organisms in the development of ecological life support systems and waste management, and determining the opportunity for enhanced genetic engineering and enhanced pharmaceutical production using bacterial systems.

Yet another BPL investigation examines a biomedical test model based on cells derived from a frog kidney. This investigation is intended to provide insight into effects of microgravity on cell behavior - especially cell division. Gravitational effects on such cell systems may be used as models of diseases or disorders that occur on Earth. For STS-57, the kidney cell system is being examined to determine feasibility for use as such a test model.

On STS-57, the BPL will consist of 40 Bioprocessing Modules (BPMs) stowed in a standard locker in the SPACEHAB Space Research Laboratory. The BPMs will contain the biological sample materials. The stowage locker also will contain an Ambient Temperature Recorder (ATR) which will provide a temperature history of the payload throughout the mission.

Each BPM consists of three syringes held together on an aluminum tray. Generally, the center syringe in each BPM will be loaded with the cell culture system. Adjacent syringes will contain process initiation and termination fluids, respectively. A three-way valve is mounted on the trays which permits fluid transfer from one syringe to the next. The syringes, valve tubing and fittings provide for containment of the sample materials. The hardware is further enclosed in heat-sealed plastic bags to provide additional levels of containment.

For most of the investigations, simultaneous ground controls will be run. Using similar hardware and identical sample fluids, ground personnel will activate and terminate BPMs in parallel with the flight crew. Synchronization will be accomplished based on voice downlink from the crew. Ground controls will be conducted at the SPACEHAB Payload Processing Facility at Cape Canaveral, Fla.

Dr. Marvin Luttges, Director of the BioServe CCDS, is Program Manager. Drs. Louis Stodieck and Michael Robinson, also of BioServe, are responsible for mission management.

Commercial Generic Bioprocessing Apparatus

The Commercial Generic Bioprocessing Apparatus (CGBA) payload is sponsored by BioServe Space Technologies, a NASA CCDS located at the University of Colorado, Boulder. The purpose of the CGBA is to allow a wide variety of sophisticated biomaterials, life sciences and biotechnology investigations to be performed in one device in the low gravity environment of space.

During the STS-57 mission, the CGBA will support 27 separate commercial investigations, which can be loosely classified in three application areas: biomedical testing and drug development, controlled ecological life support system (CELSS) development and agricultural development and manufacture of biological-based materials.

Biomedical Testing and Drug Development -- To collect information on how microgravity affects biological organisms, the CGBA will include eight biomedical test models. Of the eight test models, four are related to immune disorders: one will investigate the process in which certain cells engulf and destroy foreign materials (phagocytosis); another will study bone marrow cell cultures; two others will study the ability of the immune system to respond to infectious-type materials (lymphocyte and T-cell induction); and one will investigate the ability of immune cells to kill infectious cells (TNF-Mediated Cytotoxicity).

The other four test models -- which are related to bone and developmental disorders, wound healing, cancer and cellular disorders -- will investigate bone tissue, brine shrimp development, inhibition of cell division processes, stimulation of cell division processes and the ability of protein channels to pass materials through cell membranes.

Test model results will provide information to better understand diseases and disorders that affect human health, including cancer, osteoporosis and AIDS. In the future, these models may be used for the development and testing of new drugs to treat these diseases.

Controlled Ecological Life Support System (CELSS) Development -- To gain knowledge on how microgravity affects micro-organisms, small animal systems, algae and higher plant life, the CGBA will include 13 ecological test systems. Two of the test systems will examine miniature wasp development. Seven separate studies will concern seed germination and seedling processes related to CELSS development. Another three test systems will investigate bacterial products and processes and bacterial colonies for waste management applications. Finally, one other system will study new materials to control build-up of unwanted bacteria and other micro-organisms.

Test system results will provide research information with many commercial applications. For example, evaluating higher plant growth in microgravity could lead to new commercial opportunities in controlled agriculture applications. Test systems that alter micro-organisms or animal cells to produce important pharmaceuticals could later be returned to Earth for large-scale production. Similarly, it may be possible to manipulate agricultural materials to produce valuable seed stocks.

Biomaterials Products and Processes -- The CGBA also will be used to investigate six different biomaterials products and processes. Two investigations will attempt to grow large protein and RNA crystals to yield information for use in commercial drug development. A third investigation will evaluate the assembly of virus shells for use in a commercially-developed drug delivery system. Another experiment will use bacteria to form magnetosomes (tiny magnets) for potential use in advanced electronics. Two other investigations will use fibrin clot materials as a model of potentially implantable materials that could be developed commercially as replacements for skin, tendons, blood vessels and even cornea.

Results from the 27 investigations will be carefully considered in determining subsequent steps toward commercialization. STS-57 marks the third of six CGBA flights. Future flights will continue to focus on selecting and developing investigations that show the greatest commercial potential.

For most of the investigations, simultaneous ground controls will be run. Using identical hardware, samples fluids and materials, ground personnel will activate and terminate FPAs in parallel with the flight crew. Synchronization will be accomplished based on indications from the crew as to when specific GAPs are operated. A temperature controlled environment at the SPACEHAB Payload Processing Facility (SPPF), Cape Canaveral, Fla., will be used to duplicate flight conditions.

Dr. Marvin Luttges, Director of the BioServe CCDS, is program manager for CGBA. Drs. Louis Stodieck and Michael Robinson, also of BioServe, are responsible for mission management.

Organic Separation

The Consortium for Materials Development in Space (CMDS) based at the University of Alabama in Huntsville (UAH), has developed the Organic Separation (ORSEP) payload for flight on STS-57. The UAH CMDS is a NASA CCDS.

ORSEP offers the commercial and scientific communities the opportunity to separate cells and particles by a mechanistic technique unavailable on Earth. The potential commercial value of separations includes the opportunity to culture cell subpopulations on return to Earth, the revelation that subpopulations exist and as is the case for protein crystal growth in space, in scientific study of the purified samples.

The ORSEP hardware was built by Space Hardware Optimization Technology (SHOT), Inc., Floyd Knobs, Ind. It is of considerably lower cost than existing phase partitioning devices, and SHOT may be able to capture a good portion of the commercial market on Earth. The hardware is a modular design which can be configured for use with the Shuttle middeck, Spacelab, Get Away Special canisters, the SPACEHAB Space Research Laboratory, sounding rockets and parabolic flight aircraft.

It is a multi-sample, multi-step, fully automated device that separates non-biological particles, as well as biological cells, particles, macromolecular assemblies and organelles in low gravity via partitioning in liquid polymer two-phase systems. The hardware has been designed to perform partitioning in microgravity for a long duration because 2-3 hours are required for each separation step. Commercial interests were factored into the hardware design in its multi-sample capability that offers temperature control and sterility.

On STS-57, the SPACEHAB Space Research Laboratory makes available continuous power, which allows for constant heating/cooling for the experiment while the vacuum of space provides thermal insulation. As a result of these design features, four samples can be processed through 12 purification steps while being held at 4 degrees C in a sterile environment.

Four particle samples will be processed on STS-57 in the ORSEP apparatus. Delicate biological materials have been avoided in order to verify that the separations are due to the operation of the ORSEP rather than an unexpected response of a sensitive sample, such as to a launch delay or a delay in the recovery of the payload.

The CCR CCDS is using ORSEP to study the separation of organic materials from unwanted impurities. When making any type of drug or any material to be used for medical purposes, purity is an extremely important characteristic to the ultimate usefulness of the product. Enhanced purity will enable smaller quantities of drugs to be used, with reduced chances of unwanted side effects. When certain fluids containing pharmaceuticals are mixed in space, the two fluids will separate, much like oil and water. During this process, impurities will often separate out and be located in the boundary between the two fluids. They then may be removed, leaving the ultra-pure desired products.

The Principal Investigator for ORSEP in Dr. James M. Van Alstine, University of Alabama in Huntsville.

Protein Crystal Growth

The Center for Macromolecular Crystallography (CMC), based at the University of Alabama in Birmingham (UAB), is sponsoring Protein Crystal Growth (PCG) experiments on STS-57. The CMC is a NASA CCDS, which forms a bridge between NASA and private industry to stimulate biotechnology research for growing protein crystals in space and offers other protein crystallography services to a wide range of pharmaceutical, chemical and biotechnology companies.

The objective of space-based protein crystal growth experiments is to produce large, well-ordered crystals of various proteins. These crystals will be used in ground-based studies to determine the three-dimensional structures of the proteins. These experiments also continue to investigate how to control and optimize protein crystal growth in order to reduce uncertainties or risks associated with using this space-based process as a vital and enabling technology for many critical areas.

Since proteins play an important role in everyday life -- from providing nourishment to fighting diseases - research in this area is quickly becoming a viable commercial industry. Scientists need large, well-ordered crystals to study the structure of a protein and to learn how its structure determines a protein's functions.

The technique most-widely used to determine a protein's three-dimensional structure is x-ray crystallography, which requires large, well-ordered crystals for analysis. Crystals produced on Earth often are large enough to study, but they usually have numerous gravity-induced flaws. However, space-produced crystals tend to have more highly-ordered structures that significantly facilitate x-ray diffraction studies.

Studies of such crystals not only can provide information on basic biological processes, but they may lead to the development of food with higher protein content, highly resistant crops and - of great importance - more effective drugs. By studying the growth rates of crystals under different conditions, scientists can find ways to improve crystal growth in microgravity, thus providing higher-quality crystals for study and the ability to produce satisfactory protein crystals that are hard or impossible to grow on Earth. For these reasons, the CMC has conducted protein crystal growth experiments on 17 Shuttle missions including STS-57.

Vapor Diffusion Apparatus and Crystallization Facility Experiments

There are three PCG experiments on STS-57, two of which are contained in thermal control enclosures called Commercial Refrigerator/Incubator Modules (CRIM). One of the CRIM will hold three Vapor Diffusion Apparatus (VDA) trays at a temperature of 22 degrees C. One side of each VDA tray holds 20 double-barreled syringes, while the other side holds plugs that cap the tips of the syringes. Protein solution will be stored in one barrel of each syringe, and the other barrel will house precipitant solution. A reservoir of concentrated precipitant solution surrounds each syringe inside the crystal growth chamber.

A second CRIM contains the Protein Crystallization Facility (PFC). This equipment will utilize changing temperature as a means of producing protein crystals in microgravity. The PFC apparatus consists of four containers which can individually hold as much as 500 ml of protein solution. The buffered protein solution is initially maintained at a temperature which will not induce crystallization. Once in orbit, the CRIM is programmed by the crew to begin slowly changing temperature on a temperature profile which will optimize the crystallization process.

Due to each protein's short lifetime and the crystals' resulting instability, the protein crystal growth experiments will be retrieved within 3 hours of landing and returned to the CMC for post-flight analyses.

Direct-Control Protein Crystal Growth

A third crystallization system on STS-57 will test new protein crystal growth space hardware. The crystallization system will consist of six syringes in a VDA tray and will be contained in a Thermal Enclosure System (TES) which occupies two SPACEHAB lockers and provides a hermetically-sealed and thermally-controlled environment. Within the TES, the Crystal Observation System (COS) will allow real-time crew monitoring during the crystal growth period.

The COS video system will provide individual experiment observation via video cameras mounted to allow viewing of each growth chamber. The system will allow crew members to focus from the front of the droplet to the back, thereby providing the ability to detect individual crystals, study their growth rate and morphology, and continually observe the crystals on board or send video downlink images of the crystals to scientists in the Payload Operations and Control Center (POCC). This new hardware will provide critical information regarding differences in crystal growth rates and vapor equilibration times in the microgravity environment.

The COS in its hermetically sealed thermally controlled environment represents a significant step towards the dynamic control of the several variables that affect protein crystal growth. By developing the ability to create tailor made, monitored and programmed environments for each sample, such systems are expected to be able to significantly reduce the risks involved in growing valuable crystals of the most troublesome proteins.

Industrial samples will be flown in each of the protein crystal growth hardware - the VDA, PFC and COS - including malic enzyme from Upjohn Pharmaceuticals, recombinant human insulin from Eli Lilly and Company and alpha-thrombin from Du Pont Merck Pharmaceuticals.

The CMC has flown over 50 different types of proteins in space, seeking protein structure data and techniques for predictable enhancement by growth in microgravity. Crystallographic analysis has revealed that on average 20 percent of proteins grown in space are superior to their Earth-grown counterparts. As a result of advances made by the CMC in its microgravity crystallographic technologies, 40 percent of the proteins flown on the first United States Microgravity Laboratory (USML-1) mission in July 1992, yielded diffraction size crystals, several of which were superior to any previously grown on Earth.

With continued research, the commercial applications developed using protein crystal growth have phenomenal potential, and the number of proteins that need study exceeds tens of thousands. Current research with the aid of pharmaceutical companies may lead to a whole new generation of drugs, which could be able to help treat diseases such as cancer, rheumatoid arthritis, periodontal disease, influenza, septic shock, emphysema, aging and AIDS. These possibilities plus drugs and other products for agriculture, proteins for bioprocessing in manufacturing processes and waste management and other biotechnical applications, represent critical capabilities for dealing with the future of the world.

A number of companies are participating in the CMC's protein crystal growth project including BioCryst Pharmaceuticals, Inc., Eli Lilly & Co., Schering-Plough Research, Du Pont Merck Pharmaceuticals, Sterling Winthrop Inc., Eastman Kodak Co., The Upjohn Co., Smith Kline Beecham Pharmaceuticals and Vertex Pharmaceuticals, Inc. Principal Investigator for the protein crystal growth experiments is Dr. Charles E. Bugg, Director of the UAB CMC.

Physiological Systems Experiment

The Center for Cell Research (CCR), a NASA CCDS based at Pennsylvania State University, is sponsoring the third Physiological Systems Experiment (PSE) payload on STS-57.

The PSE-03 payload is the result of a collaboration by the CCR and the Space Dermatology Foundation (SDF), a group of dermatologists and scientists concerned with the future implications and effects of space travel and habitation on the human skin. It will investigate the role of two growth factors involved in accelerating or enhancing tissue repair. Microgravity appears to slow down the normal tissue repair process. The slow down mimics changes associated with conditions on Earth.

The objective of PSE-03 on STS-57 is to increase the dermatologic database and to demonstrate the value of microgravity in dermatologic studies. The results of the experiment will be shared with the medical community and the pharmaceutical and biotechnical industries through the SDF. The SDF plans to develop and maintain a database of space-related dermatology and dermatologic conditions, which will be the only one of its kind.

PSE-03 is a first step in exploring how microgravity can improve the understanding of the ways growth factors regulate tissue repair and regeneration. The knowledge gained in these studies may be useful in the development of new medicines for burn victims, diabetics, elderly surgical patients, bed sore sufferers or other skin injury patients for whom healing is slow and difficult.

The results also may provide additional information about how the basic gene processes underlying blood vessel and soft tissue formation are turned on and off. In addition, the experiment may have direct application in space by helping dermatologists devise therapies to treat astronauts who receive skin and/or soft tissue injuries during prolonged space flight.

Prior to space flight, the growth factors will be implanted in six different areas in each of the 12 male adult rats. The rats will be housed in groups of six in two completely self-contained units equipped with food and water. Fans will circulate cabin air through the units. The units, known as Animal Enclosure Modules (AEM), were developed by NASA's Ames Research Center, Mountain View, Calif. The AEM hardware provides the rats with appropriate life support throughout the mission and returns them in good health at the end of the mission. No interaction with the crew is required in orbit, however, clear plastic covers on the AEM hardware will permit the crew to visually inspect the condition of the rats.

When returned, the tissues surrounding the implantation sites will be examined to determine the effect of the growth factors. Those tissues and others will be studied by researchers affiliated with the CCR, SDF and with pharmaceutical and biotechnical companies. The experiment designers expect the 7 day mission to provide sufficient exposure to microgravity to study the initial phases of tissue repair and the manner in which the two growth factors affect the process.

PSE-01, conducted in 1990 with Genentech Inc., San Francisco, increased basic scientific knowledge regarding human bone and muscle disease and immune cell deficiency. PSE-02, conducted in 1992 with Merck & Co., Inc., West Point, Penn., tested a developmental drug designed to counteract the effects of osteoporosis.

Dr. W. C. Hymer is Director of the Center for Cell Research at Pennsylvania State University and co-investigator for PSE-03. Dr. William W. Wilfinger is the CCR Director of Physiological Testing. Dr. Steven R. Kohn, President, Space Dermatology Foundation, is the SDF representative.

SPACEHAB-01 Johnson Space Center Investigations

Application Specific Pre-programmed Experiment Culture System

The Application Specific Pre-programmed Experiment Culture (ASPEC) System is sponsored by the Medical Sciences Division, Space and Life Sciences Directorate, NASA Johnson Space Center (JSC), Houston. The ASPEC system is a part of the bioreactor project which is aimed at developing a series of hardware concepts for facilitating the development of human cells and tissue cultures in the weightless or microgravity environment of space flight where cells can grow in all directions for extended periods of time.

Medical science is unable to grow large high-fidelity human tissue models in Earth's gravity. Microgravity or its emulation will allow cells to be suspended for long-term growth and development. Tissues grown in this way are useful in testing chemotherapeutic protocols, understanding growth requirements and treating specific medical maladies. Potential medical science spin-offs include investigations of viral growth, cancer models and therapeutics, and transplantation tissue.

"A near-term goal is to test the equipment and its impact on a growing colon cancer," said Glenn Spaulding, Manager of the biotechnology program at the Johnson Space Center. "From this study, we will be able to refine culture techniques here and in space."

The ASPEC system is a set of self-contained cell growing and cell maintenance units for use in space flight experiments. Cell cultures may be initiated in the device or mature cell cultures may be transferred into the ASPEC, which can maintain a cell culture experiment for as long as 14 days.

The ASPEC system will carry several culture vessels on STS-57, its first space flight. Each culture vessel has the potential of carrying one complete experiment. On STS-57 the experiment is being flown with colon cancer cells to be grown in the chamber and brought back for study. On Endeavour's last mission in January, the culture chamber was flown as a testbed to demonstrate movement of fluid through the unit to provide constant nutrients to growing cells.

The hardware of the ASPEC system includes three ASPEC units, an ASPEC power cable, a locker with a modified door and packing foam. Each ASPEC unit has an independent plumbing and sensor system to regulate temperature and pH and to provide a fresh growth medium and serum to the cells as needed.

The STS-57 crew will routinely check power indicators and airflow through the ASPEC units and clean the vent screens as necessary. The crew also will take still photographs of the system configuration. The shutdown procedure will be initiated by the crew. This will begin an automated process for removing experiment materials from the reactor chamber, chilling the removed samples to 10 degrees C to prevent protein breakdown and other degradation and injecting formalin into the vessels to "fix" the remaining cells.

A near term goal of the experiment is to provide toxicology testing that will identify the potential long-duration hazards on shorter Shuttle missions. This forms a bridge between identifying specific toxicants and their biological impacts.

On the Shuttle, ASPEC will serve as the "foundation experiment" for the space station. Growing cells to full maturity may take several months, which can only be done on long-duration flights aboard the station.

Principal Investigator for ASPEC is Dr. Glenn Spaulding, Medical Sciences Division, Space and Life Sciences Directorate, JSC.

Charged Particle Directional Spectrometer

The Charged Particle Directional Spectrometer (CPDS) experiment on STS-57 is sponsored by the Solar System Exploration Division, Space and Life Sciences Directorate, Johnson Space Center (JSC). The CPDS performs the functions of both a research instrument and an operational monitor. It detects and records the many different types of nuclear radiation that bombard an orbiting space vehicle. In so doing, information is gathered about the characteristics of these particles at the orbital altitude, and a record is made of the amount and type of exposure the crew members receive.

The particles come from two groups. First are particles trapped in orbit around the Earth by the Earth's magnetic field. These particles mainly consist of protons, although other varieties of the nuclear population also are present. The second are intergalactic particles, or cosmic rays, that happen to be passing by the Earth. All of these particles can be considered orbital debris on a nuclear scale.

Knowledge of the particle's type, energy and direction is of interest to basic research in physics. Medical researchers can use much of the same information, but in addition, they are concerned with the linear energy transfer of the particle, particularly in living tissue such as human beings. The measurement indicates how much potential damage the particles do as they transverse through living beings. Such information is necessary to help determine guidelines that will ensure the long-term health and safety of astronauts. Several CPDS instruments are intended to be included as standard equipment on the space station.

The CPDS experiment consists of three different instruments: a pair of Area Passive Dosimeters (APDs), the Tissue Equivalent Proportional Counter (TEPC) and the actual CPDS apparatus. The APDs are routinely flown on Space Shuttle missions. They are similar to film strips. Particles which strike the strips leave a distinctive signature. The strips are analyzed after the flight and give a good indication of total dosage received during the flight.

The TEPC utilizes a detection element that absorbs particle energy in a manner similar to living tissue. The data received from this instrument are particularly useful in assessing possible hazards to the crew. And since the TEPC is an active electronic instrument, a time record of when each particle strikes is maintained. TEPCs have flown on several Shuttle missions and have been instrumental in, among other things, determining the configuration of the South Atlantic Anomaly.

The CPDS apparatus is the most sophisticated instrument of the experiment hardware. It consists of several layers of different types of detectors. The various detectors have different characteristics to enable the instrument to gather as much data as possible from each particle strike. One important new feature of the CPDS is its ability to determine the direction of individual particles. Particle flux is believed to be more intense in some directions than in others. If this is confirmed, future spacecraft designs may position crews to receive maximum shielding from the spacecraft structure.

The CPDS experiment is completely housed in a SPACEHAB locker mounted high on the aft bulkhead. It requires only electrical power to be operational. The instruments are activated by the crew as soon after reaching orbit as practical and are turned off just before the descent back to Earth. Data are retained in internal memories and are read out and analyzed post-flight.

Principal Investigator for CPDS is Dr. Gautam D. Badwar, Solar System Exploration Division, Space and Life Sciences Directorate, JSC.

Human Factors Assessment

The Human Factors Assessment (HFA) experiment is being conducted on STS-57 by the Crew Interface Analysis Section of the Flight Crew Support Division, Space and Life Sciences Directorate, Johnson Space Center (JSC). The primary concerns of human factors engineers at JSC are the investigation and evaluation of human-machine and human-environment interfaces unique to spaceflight which affect crew productivity and ultimately mission success.

During the mission, data will be collected on three different aspects of crew activity in space: the acoustic and lighting environments of the orbiter, ease of movement -- or translation -- through the middeck-to-SPACEHAB transfer tunnel and the use of electronic procedures to perform tasks. The hardware to facilitate data collection includes a MacIntosh Powerbook computer with a voice recognition system using Supercard displays and for environmental measurements, a B&K Type 2231 Modular Precision Sound Level Meter and a Minolta Photographic Spotmeter.

Evaluation of the acoustic and lighting environments (HFA-SOUND and HFA-LIGHT, respectively) seeks to gain objective and subjective measures of the noise and lighting environments during the STS-57 mission and also will assess any effects on crew performance attributable to these environments. HFA-SOUND additionally seeks to determine if noise is more bothersome to the crew as the mission progresses and to compare noise levels and crew-perceived annoyance across missions.

The HFA-SOUND and -LIGHT investigations will determine whether current spacecraft acoustic and lighting design criteria are being met, and what levels are indeed acceptable to the crew during the mission to minimize negative effects of these environments on crew performance. Ten 1/3 octave sound level and several lighting measures will be taken in the SPACEHAB Space Research Laboratory, the middeck and the flight deck. This investigation will help identify noise-producing hardware and problematic lighting configurations that are particularly detrimental to crew member performance.

The investigation assessing translation through the transfer tunnel (HFA-TRANS) seeks to assess the SPACEHAB tunnel adapter and hatch designs for ease of crew translation and equipment transfer between the middeck and the SPACEHAB Space Research Laboratory.

HFA-TRANS data will provide basic information on translation speeds in the weightless environment of space and techniques which will contribute to training and timelining of tasks for subsequent SPACEHAB and Spacelab missions and on the space station. The data also will be compared to data collected on crew translation through the Spacelab tunnel during STS-40 (June 1991) and STS-47 (September 1992).

Comments on the various features of the SPACEHAB adapter and tunnel designs will contribute to recommendations for the design of more efficient translation areas in the future. Translation video will be collected early and late in the mission.

The electronic procedures portion of this experiment (HFA-EPROC) seeks to facilitate future use of electronic flight procedures. Crew performance with electronic procedures must be at least equal to that achieved with paper procedures.

Current EPROC research will help define baseline paper procedures performance and identify specific strong and weak points of both paper and computer procedures. The current research also will help define specific ways to achieve improved performance with computer procedures.

EPROC will be of particular significance for future, longer-duration missions which will increasingly rely on electronic procedures since they are more easily launched, updated in flight and offer automatic or on-request capabilities not available with paper. The development of human factors design guidelines for such electronic procedures will be increasingly important for future space missions.

The HFA-EPROC experiment consists of two tasks: a computer task which will simulate a space station propulsion system task and a non-computer task performed in conjunction with the Tools and Diagnostic Systems Soldering Experiment. Each task will be performed with paper and computer-based procedures.

The Principal Investigator for HFA is Sue Adam, Flight Crew Support Division, Space and Life Sciences Directorate, JSC.

Neutral Body Posture

The Space and Life Sciences Directorate, JSC, is sponsoring the Neutral Body Posture (NBP) experiment on STS-57. NBP will investigate the changes in posture of the human body over the course of a space mission.

Previous space missions have shown that in addition to lengthening of the spine, posture takes on a configuration unique to spaceflight. The data from NBP will be useful in the design of future space facilities, workstations and hardware, especially since the last in-depth study of this nature was conducted during the Skylab program in the early 1970s.

A minimum of two STS-57 crew members will be evaluated. As time allows, data may be collected on additional crew members. The crew members to be evaluated will wear a special sleeveless T-shirt and be photographed with orbiter camcorders and 35mm cameras mounted roughly along orthoganal axes with respect to the vehicle. The crew members under evaluation will assume a relaxed position while photos are collected. This process will be performed both early and late in the mission.

Principal Investigator for NBP is Frances E. Mount, Flight Crew Support Division, Space and Life Sciences Directorate, JSC.

Tools and Diagnostic Systems

The Tools and Diagnostic Systems (TDS) experiment is sponsored by the Space and Life Sciences Directorate, JSC. The objective of TDS is to demonstrate the maintenance of experiment hardware on-orbit and evaluate the adequacy of its design and the crew interface. The TDS experiment on STS-57 will mark the first demonstration of soldering on an American space mission.

The TDS experiment is a group of equipment selected from the diagnostic equipment to be supplied to the space station program. 'ı and diagnostic equipment will provide the space station program with diagnostic and repair capability. The hardware consists of off-the-shelf equipment modified to perform acceptably in the space environment.

There are two parts to TDS: the Soldering Experiment (SE) to demonstrate practical soldering in the microgravity environment and to evaluate the use of a new restraint configuration for crew members performing precise tasks and the Diagnostic Equipment (DE) experiment to demonstrate microgravity maintenance capabilities using state-of-the-art diagnostic equipment.

In the SE, a crew member will solder a printed circuit board containing 45 connection points, then de-solder 35 points on a similar printed circuit board. The soldering work station consists of a glovebox to contain debris, mounted on a SPACEHAB-supplied work bench, where the circuit boards will be held in a clamp, which is in turn mounted on an experiment rack. Of interest to investigators are the techniques used by the crew member and the quality of the work of the crew member, which is dependent on the ability of the crew member to properly place the solder on the heated connection point.

The crew member also will be asked to evaluate two types of foot restraints used while performing the SE. One restraint consists of adjustable foot loops similar to the current Space Shuttle design. The other is an arrangement of foot restraint bars designed for use on the space station. Two crew members will perform the experiment twice, but it may be repeated if time allows.

The DE experiment will operate the development unit for the space station diagnostic equipment caddy. This diagnostic caddy contains a function sweep generator, a logic analyzer/oscilloscope and a multimeter. This combination of equipment is able to produce an analog or digital test signal, which is input to the test equipment, and captures and displays the resultant output.

The work station consists of the SPACEHAB-supplied work bench mounted on a rack, which provides a recess into which the diagnostic equipment caddy will be mounted. A frequency counter also is supplied for analysis.

As part of the DE experiment, a failure in flight will be simulated, after which the Payload General Support Computer (PGSC) will uplink a troubleshooting procedure, a test equipment configuration file and a test setup diagram. The file to configure the test equipment will allow the complex diagnostic equipment setup to be performed by the support crew on the ground. Then the flight crew will perform the procedures and record and downlink the results.

The ground crew will analyze the data obtained and uplink files for a "fix" to the problem for the crew. Upon completion of the repair, the test will culminate with successful performance of the frequency counter's function.

The Principal Investigator for TDS is Jackie Bohannon, Flight Crew Support Division, Space and Life Sciences Directorate, JSC.

SPACEHAB-01 Payloads Space Station Experiment

Environmental Control and Life Support System Flight Experiment

NASA's space station office in Reston, Va., is sponsoring the Environmental Control and Life Support System (ECLSS) Flight Experiment (EFE) to test components of the water recycling system being developed for the space station.

With a projected rate of four crew members at a time aboard the space station, they will use about 50 pounds of water a day. Without an efficient system for reusing this water over and over again, about 10 tons of water would have to be sent to the space station every 90 days, requiring special Space Shuttle flights just for the replenishment of the water supply.

Engineers at the Marshall Space Flight Center (MSFC), Huntsville, Ala., have succeeded in developing a prototype system that can recycle shower and wash water, urine and even respiration and perspiration captured from the air back into potable drinking water. Taste tests and other end-use tests run at MSFC during 1992 demonstrated that the systems work well and that the recycled water is clean and acceptable for crew use. However, now the systems must be tested onboard the Space Shuttle in low Earth orbit to make sure they perform just as well in the microgravity environment of space flight.

The EFE consists of three pieces of recycling hardware -- a bellows tank, a gas/water phase separator and two unibeds (filters). These components will be housed in two containers occupying the equivalent of four lockers in the forward bulkhead of the SPACEHAB Space Research Laboratory. The bellows tank features a Pyrex see-through window that will allow crew members to observe how gas and water behave inside the tank in microgravity -- examining, for instance, whether the air bubbles colonize or cling to the tank walls. The phase separator will separate the gas from the mixture.

The experiment also will carry about a half gallon of pure water, into which will be mixed potassium iodide (simulating a wastewater contaminant). The iodide mixture will be run through the unibed filters to purify the water. The purification experiment will test both the efficiency of the unibeds in purifying the water and the rate at which the unibeds are depleted.

Two types of unibeds will be flown on STS-57 as part of the ECLSS Flight Experiment, one which is spring-loaded and the other which is not. The two types will be tested to determine if the spring is required for the unibeds to work properly in the microgravity environment. If it is not required, the spring can be eliminated to reduce the weight of the hardware.

The current industry affiliates on the ECLSS Flight Experiment are Boeing Aerospace, Life Systems, Inc., and Hamilton Standard. The Principal Investigators for the ECLSS Flight Experiment are NASA Marshall Space Flight Center, Huntsville, Ala., and Boeing Aerospace.

SPACEHAB-01 Payloads Supporting Hardware

Three-Dimensional Microgravity Accelerometer

The Consortium for Materials Development in Space (CMDS), is sponsoring the Three-Dimensional Microgravity Accelerometer (3-DMA) on the STS-57 mission. The CMDS is a NASA CCDS based at the University of Alabama, Huntsville (UAH).

The acceleration measurement system will help chart the effects of deviations of microgravity on the experiments being conducted in space. The microgravity environment inside the SPACEHAB Space Research Laboratory will be measured in three dimensions by the 3-DMA, allowing researchers to review experiment results against deviations from microgravity. This information will be used to determine the degree of microgravity achieved inside the SPACEHAB Space Research Laboratory. Disturbances caused by operating various experiments in SPACEHAB and the residual microgravity resulting from orbiter rotational motions and by drag will be measured.

The 3-DMA hardware consists of four accelerometer assemblies to be located in different parts of the SPACEHAB Space Research Laboratory. The accelerometers provide the acceleration data to a central control box located in a single locker. The data are recorded in flight on two gigabyte magnetic hard drive devices.

The accelerometer package comprises three remotely located standard three-dimensional systems and new invertible accelerometers in the central unit. The new, unique invertible feature permits measurements of absolute microgravity and low-level, quasi-steady, residual accelerations (i.e., atmospheric drag) that have proven difficult to measure in the past.

A potential application of 3-DMA would be to characterize the microgravity environment of space platforms in support of experiments, research and commercialization activities.

Principal Investigator for 3-DMA is Jan Bijvoet of the UAH CMDS.

Space Acceleration Measurement System

NASA's Lewis Research Center (LeRC), Cleveland, is sponsoring the Space Acceleration Measurement System (SAMS) on the STS-57 mission. SAMS is designed to measure and record low-level acceleration during experiment operations. The signals from these sensors are amplified, filtered and converted to digital data before being stored on optical disks and sent via downlink to the ground control center.

SAMS has flown on six previous Shuttle flights and acquired nearly 15 gigabytes of data which represents 50 days of operation. Approximately two gigabytes of data will be acquired on the SPACEHAB mission.

The high density floppy disks have approximately one megabyte of capacity. The capacity of a double-sided optical disk used on Shuttle missions is 400 megabytes. This compares to approximately 400 high density floppy disks or 40 standard boxes of ten disks. All the data will fit on one optical disk measuring about 5 inches square and one-half inch thick.

Three sensors will be flown. One will measure the disturbances near an Environmental Control Support System, another sensor will be located on the support structure of the SPACEHAB Space Research Laboratory and the third will be attached to a locker door to determine the level of disturbances experienced by experiments in the locker and nearby. The second and third sensors are primarily to measure the acceleration characteristics of the SPACEHAB Space Research Laboratory for future experiments.

Scientists will use the SAMS data in different ways, depending on the nature of the science experiment and the principal investigators' experience and ground-based testing results. The principal investigators will typically look for acceleration events or conditions that exceed a threshold where the experiment results could be affected. This may be, for example, a frequency versus amplitude condition, an energy content condition or simply an acceleration magnitude threshold.

Data from previous missions have shown the levels of disturbance evident in the Spacelab module by the use of the crew exercise treadmill located in the middeck. This data, along with other missions' data, are important in order to reduce and isolate disturbances on future missions, including on the space station.

SAMS flight hardware was designed and developed in-house at LeRC. The Principal Investigator for SAMS is Charles Baugher of NASA's Marshall Space Flight Center, Huntsville, Ala., and the Project Manager is Richard DeLombard of NASA Lewis.

SPACEHAB-01 COMMERCIAL MATERIAL SCIENCE EXPERIMENTS OVERVIEW

Experiment	Sponsor	Affiliates	Experiment Description	Potential Commercial Applications
Equipment for Controlled Liquid Phase Sintering Experiment-SPACEHAB (ECLiPSE)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS*)	Wyle Laboratories Kennametal, Inc.	Uses a rack-mounted, enclosed furnace assembly to investigate controlled liquid phase sintering of metallic systems in microgravity.	Development of stronger, lighter and more durable bearings, cutting tools, electrical contact points, and irregularly shaped parts for high stress environments.
Gas Permeable Polymer Materials (GPPM)	NASA Langley Research Center, Hampton, Va.	Paragon Optical Co.	Processes gas permeable polymer materials in microgravity.	Development of rigid extended-wear contact lenses with improved comfort and durability.
Investigations into Polymer Membrane Processing (IPMP)	Battelle Advanced Materials Center, Columbus, Ohio (CCDS*)	Amoco Chemical Co. DuPont Bend Industries, Inc.	Evaporates mixed solvent systems in microgravity using induced convection to control the porosity of polymer membranes.	Improvement of kidney dialysis, water purification and water desalination.
Liquid Encapsulated Melt Zone (LEMZ)	Consortium for Commercial Crystal Growth, Potsdam, N.Y. (CCDS*)	Rockwell International McDonnell Douglas State of Florida Technology Research and Development Authority University of Florida (Gainesville)	Explores the feasibility of liquid encapsulated melt zone processing in microgravity, and studies the interaction of the encapsulate with the melt and the effects of gravity perturbation on the system.	Development of next-generation electronic and radiation-hardened devices to support data, sensor and control systems.
Support of Crystal Growth (SCG)	Battelle Advanced Materials Center, Columbus, Ohio (CCDS*)	Amoco Chemical Co. Du Pont Worcester Polytechnic Institute	Provides inofrmation required to establish the Zeolite Crystal Growth experiment mixing protocol.	Support of zeolite crystal applications.
Zeolite Crystal Growth (ZCG)	Battelle Advanced Materials Center, Columbus, Ohio (CCDS*)	Amoco Chemical Co. Du Pont Worcester Polytechnic Institute	Evaluates the growth of zeolite crystals in microgravity.	Improvement of gasoline refining, water purification, blood impurity removal and radioactive waste clean-up.

* NASA Center for the Commercial Development of Space

SPACEHAB-01 COMMERCIAL LIFE SCIENCE EXPERIMENTS OVERVIEW

Experiment	Sponsor	Affiliates	Experiment Description	Potential Commercial Applications
ASTROCULTURE™	Wisconsin Center for Space Automation and Robotics, Madison, Wis. (CCDS*)	Automated Agriculture Assoc., Inc. Biotronics Technologies, Inc. Quantum Devices, Inc. Orbital Technologies Corp.	Validates a concept for supplying water and nutrients to plants growing in microgravity.	Development of an enclosed environmental system with earth-based and space-based uses, including improved dehumidification/ humidification and energy efficient lighting.
BioServe Pilot Laboratory (BPL)	BioServe Space Technologies, Boulder, Colo. (CCDS*)	Abbot Labs Alza Aquatic Products Chiron Martin Marietta Spaceport Florida Authority Synchrocell	Determines the response of cells to various hormones and stimulating agents in microgravity.	Development of next-generation drugs and space-grown polymers.
Commercial Generic Bioprocessing Apparatus (CGBA)	BioServe Space Technologies, Boulder, Colo. (CCDS*)	Abbot Labs Aquatic Products Chiron Martin Marietta OmniData Spaceport Florida Authority Synchrocell Water Technologies	Processes biological fluids by mixing components in a microgravity environment.	Improvement of bio-implantable products, immune disease research and waste management systems.
Organic Separation (ORSEP)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS*)	Interfacial Dynamics Corp. Space Hardware Optimization Technology, Inc.	Explores the use of phase separation techniques in microgravity conditions to separate cells, cell fragments and heavy molecules.	Improvement of techniques for processing pharmaceutical and biotechnology products.
Protein Crystal Growth (PCG) Thermal Enclosure System with Crystal Observation System (TES-COS)	Center for Macromolecular Crystallography, Birmingham, Ala. (CCDS*)	BioCryst Pharmaceuticals, Inc. Eli Lilly & Co. Schering-Plough Research Du Pont Merck Pharmaceuticals Sterling Winthrop, Inc. Eastman Kodak Co. The Upjohn Co. Smith Kline Beecham Pharmaceuticals Vertex Pharmaceuticals, Inc.	Grows high-quality protein crystals by vapor diffusion. TES includes the Crystal Observation System (COS) to monitor crystal growth in realtime.	Acceleration of drug research and development.
Physiological Systems Experiment (PSE)	Center for Cell Research, University Park, Pa. (CCDS*)	Space Dermatology Foundation	Determines the effects of biomaterials on animal physiological systems.	Design and development of medicines to treat terrestrial diseases, such as osteoporosis, which are mimicked during space exposure.

* NASA Center for the Commercial Development of Space

SPACEHAB-01 JOHNSON SPACE CENTER (JSC) EXPERIMENTS OVERVIEW

Experiment	Sponsor	Experiment Description	Potential Applications
Application Specific Pre-programmed Experiment Culture (ASPEC)	Medical Sciences Division, Space and Life Sciences Directorate, JSC	Controls cell culture variables to optimize the assembly of tissues from basic cells and substrates.	Development of human cells and tissue cultures in microgravity useful in testing chemotherapeutic protocols, understanding growth requirements and treating specific medical maladies.
Charged Particle Directional Spectrometer (CPDS)	Solar System Exploration Division, Space and Life Sciences Directorate, JSC	Measures charge and direction of atomic particles in the Space Shuttle/SPACEHAB environment.	Improvement of crew health during long-duration space missions.
Human Factors Assessment (HFA)	Crew Interface Analysis Section, Flight Crew Support Division, Space and Life Sciences Directorate, JSC	Measures and evaluates the Space Shuttle/SPACEHAB environment including acoustics and lighting; computerized polling of crew opinion, crew movement and interaction with equipment.	Evaluation of human-machine and human-environment interactions during routine operations of the SPACEHAB Space Research Laboratory.
Neutral Body Posture (NBP)	Flight Crew Support Division, Space and Life Sciences Directorate, JSC	Analyzes the effects of microgravity on human posture.	Design of future space facilities, workstations and hardware.
Tools and Diagnostics System (TDS)	Flight Crew Support Division, Space and Life Sciences Directorate, JSC	Evaluates microgravity effects on the physics and human factors of electronic circuit board soldering, the operation of a portable battery charger, and the operation of a portable electronic diagnostic equipment package.	Demonstration of experiment hardware maintenance in orbit, including the first demonstration of soldering on an American space mission.

SPACEHAB-01 SPACE STATION

Experiment	Sponsor	Affiliates	Experiment Description	Potential Applications
Environmental Control Life Support System (ECLSS) Flight Experiment	Space Station *Freedom* Office, Reston, Va.	Boeing Aerospace Life Systems, Inc. Hamilton Standard	Investigates the performance of key components for a water reclamation and management system.	Development of key components for Space Station *Freedom*, such as an enhanced water reclamation system.

SPACEHAB-01 SUPPORTING HARDWARE OVERVIEW

Hardware	Sponsor	Hardware Operation	Potential Applications
Three Dimensional Microgravity Accelerometer (3DMA)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS*)	Measures accelerations in three axes within the SPACEHAB environment.	Characterization of low-gravity environment for the development of space hardware and for experiment data analysis.
Space Acceleration Measurement System (SAMS)	NASA Lewis Research Center, Cleveland, Ohio		

* NASA Center for the Commercial Development of Space

Commercial Generic Bioprocessing Apparatus Investigations on STS-57

<u>Biomedical Testing and Drug Development</u>

These investigations will provide information to develop a better understanding of diseases and disorders that affect human health including cancer, osteoporosis and AIDS. These models may be used for the development and testing of new drugs to treat these diseases.

Experiment	Investigator	Experiment Description	Specific Application
T-Cell Induction Test Model	Kansas State University	Examines immune system's ability to respond to infectious-type materials.	Immune Disorders
TNF-Mediated Cytotoxicity Test Model	Kansas State University	Examines immune cells' ability to kill infectious cells.	Immune Disorders
Bone Marrow Cell Culture Test System	Kansas State University	Studies bone marrow cultures in microgravity.	Immune Disorders
Phagocytosis Process Testing	University of Rochester	Investigates process in which certain cells engulf and destroy foreign materials.	Immune Disorders
Brine Shrimp Test System	Kansas State University	Examines brine shrimp development in microgravity.	Developmental Disorders
Inhibitor Protein Test Model	Kansas State University	Studies inhibition of cell division processes.	Cancer
Gap Junction Processes	Kansas State University	Investigates ability of protein channels to pass materials through cell membranes.	Cellular Disorders
Cell Division Processes	University of Colorado	Studies stimulation of cell division processes.	Cellular Disorders

Commercial Generic Bioprocessing Apparatus Investigations on STS-57

Controlled Ecological Life Support System (CELSS) Studies

These investigations could lead to new commercial opportunities in controlled agriculture applications, large scale production on Earth of important pharmaceuticals, and production of valuable see stocks by manipulation of agricultural materials.

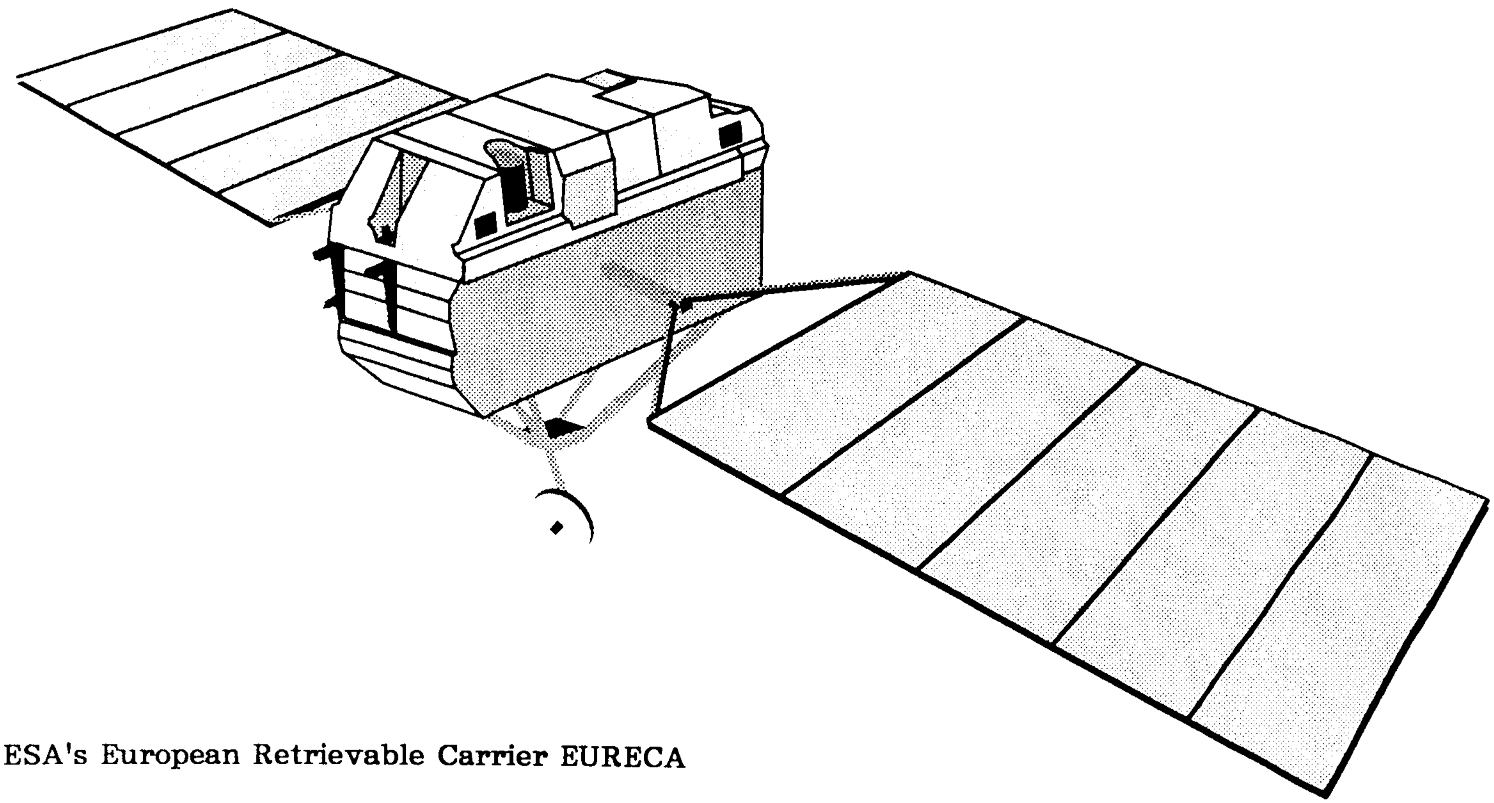
Experiment	Investigator	Experiment Description	Specific Application
Seed Germination Products (4 studies)	University of Colorado	Studies seed germination in microgravity.	Controlled Ecological Life Support System (CELSS) Studies
Seeding Processes (2 studies)	Kansas State University	Examines seeding processes in microgravity.	CELSS Studies
Plant Tissue Culture Products	University of Colorado	Studies secondary metabolic production during spaceflight.	CELSS Studies
Miniature Wasp Test System	University of Colorado	Investigates miniature wasp development in microgravity.	CELSS Studies
Fruit Fly Test System	Kansas State University	Examines fruit fly development in microgravity.	CELSS Studies
Bacterial Products and Processes	University of Colorado	Studies bacterial products and processes in microgravity.	Waste Management
Bacterial Products and Processes	Kansas State University	Studies bacterial products and processes in microgravity.	Waste Management
Bacterial Colony Test System	University of Colorado	Studies bacterial products, processes and colonies in microgravity.	Waste Management
Pentaiodide Product Testing	University of Colorado	Investigates new materials to control build-up of unwanted bacteria and other micro-organisms.	Microbial Control

Commercial Generic Bioprocessing Apparatus Investigations on STS-57

Biomaterials Products and Processes

Potential applications of these investigations include commercial drug development and a drug delivery system, and the development of potentially implantable materials used commercially as replacements for skin, tendons, blood vessels and cornea.

Experiment	Investigator	Experiment Description	Specific Application
Virus Capsid Product	Kansas State University	Evaluates assembly of virus shells.	Drug Delivery System
Protein Crystal Morphology Products	University of Colorado	Growth of large protein crystals.	Drug Development
RNA Crystal Growth Products	University of Colorado	Growth of large RNA crystals.	Drug Development
Magnetosome Assembly Processes	University of Colorado	Formation of magnetosomes (tiny magnets) using bacteria.	Advanced Electronics
Fibrin Clot Materials (2 studies)	University of Colorado	Use of fibrin clot materials as a model of potentially implantable materials.	Synthetic Implants



ESA's European Retrievable Carrier EURECA

EUROPEAN RETRIEVABLE CARRIER (EURECA)

F. Schwan - Industrial Project Manager
Deutsche Aerospace, ERNO Raumfahrttechnik
Bremen, Germany

W. Nellessen - ESA Project Manager
ESTEC
Noordwijk, The Netherlands

The European Space Agency's (ESA) EURECA spacecraft was launched on July 31, 1992, by the Space Shuttle Atlantis (STS-46) and deployed at an altitude of 230 nautical miles (425 km). It ascended using its own propulsion to the operational orbit of 270 nautical miles (500 km). Several weeks prior to the STS 57 launch, ground controllers will lower EURECA's altitude where it will be retrieved by Endeavour and brought back to Earth.

The EURECA-1 mission primarily has been devoted to research in the fields of material and life sciences and radiobiology, all of which require a controlled microgravity environment. The selected microgravity experiments have been carried out in seven facilities. The remaining payload comprises space science and technology.

During the mission, EURECA's residual carrier accelerations have not exceeded 10^{-5}g. The platform's altitude and orbit control system made use of magnetic torquers augmented by cold gas thrusters to keep disturbance levels below 0.3 Nm during the operational phase.

Physical characteristics

• Launch mass	9,900 lbs (4491 kg)
• Electrical power solar array	5000 W
• Continuous power to EURECA experiments	1000 W
• Launch configuration	dia: 14.76 ft (4.5 m.) length: 8.33 ft (2.54 m)
• Volume	132 cubic ft (40.3 m)
• Solar array extended	66 ft x 11.5 ft (20 m x 3.5 m)

User friendliness

Considerable efforts have been made during the design and development phases to ensure that EURECA is a "user friendly" system. As is the case for Spacelab, EURECA has standardized structural attachments, power and data interfaces. Unlike Spacelab, however, EURECA has a decentralized payload control concept. Most of the onboard facilities have their own data handling device so that investigators can control the internal operations of their equipment directly. This approach provides more flexibility as well as economical advantages.

Operations

All EURECA operations are controlled by ESA's Space Operations Centre (ESOC) in Darmstadt, Germany. During the deployment and retrieval operations, ESOC functions as a Remote Payload Operations Control Centre to NASA's Mission Control Center, Houston, and the orbiter is used as a relay station for all the commands.

Throughout the operational phase, ESOC has controlled EURECA through two ground stations at Maspalomas, Canary Islands (Spain), and Kourou, French Guiana. EURECA has been in contact with its ground stations for a relatively short period each day. When it was out of contact, its systems operated with a high degree of autonomy, performing failure detection, isolation and recovery activities to safeguard ongoing experimental processes.

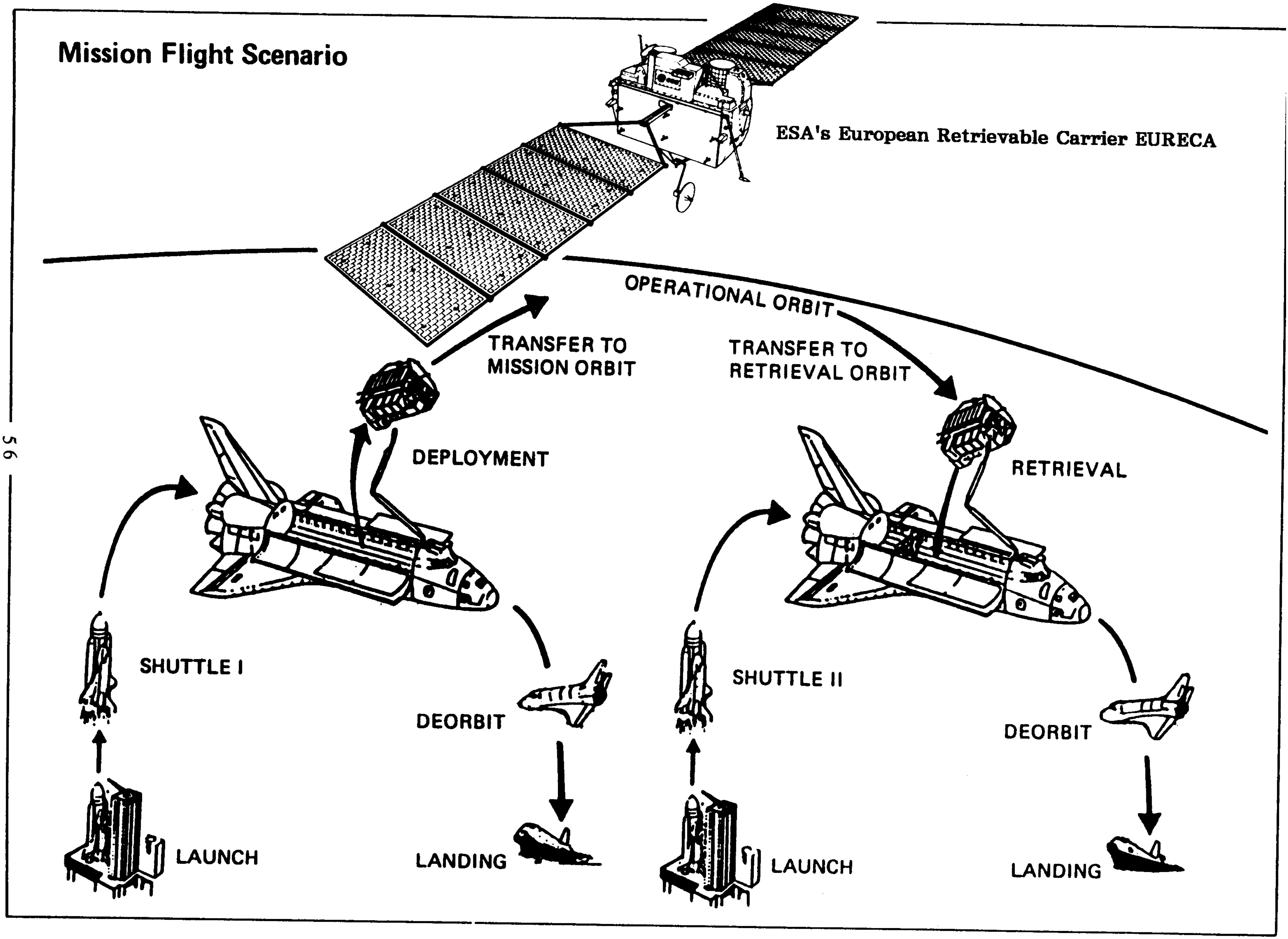
An experimental advanced data relay system, the Inter-orbit Communication Package, was included in the payload. This package communicated with the European Olympus Communication Satellite to demonstrate the possible improvements for future communications with data relay satellites. Such a system will significantly enhance real time data coverage.

EURECA Retrieval Operations

The EURECA free-flying experiment platform will be retrieved on the fourth day of STS-57. EURECA was deployed from Atlantis on STS-46 on Aug. 1, 1992. During its approximately10-month stay in orbit, EURECA has supported investigations in processing metallurgical samples, growing crystals and conducting biological and biochemical studies. Several weeks before the STS-57 launch, EURECA controllers will lower the spacecraft's orbit from 270 nautical miles (500 km) high to 257 nautical miles (300 km) in preparation for the retrieval.

David Low will grasp the 5-ton EURECA with the Shuttle's robot arm and lower the platform into latches in the aft cargo bay.

Mission Flight Scenario



Beginning on flight day one, a series of engine firings will adjust Endeavour's catch-up rate so that on the morning of flight day four, a final altitude adjustment burn will move Endeavour up to the 257-nautical-mile EURECA orbit. During the catch-up maneuvers, Endeavour's onboard navigational star trackers will sight on EURECA during the best lighting period, from noon to sunset of each orbit, to provide the most accurate course correction information for each maneuver.

For the final mid-course corrections, the crew will use Endeavour's rendezvous radar to refine their information about the position of EURECA in relation to Endeavour. For about the final one and a half miles of Endeavour's approach to EURECA, Commander Ron Grabe will fly the Shuttle's maneuvers manually.

EURECA RETRIEVABLE CARRIER

Structure

The EURECA structure is made of high strength carbon-fibre struts and titanium nodal points joined together to form a framework of cubic elements. This provides relatively low thermal distortions, allows high alignment accuracy and simple analytical verification, and is easy to assemble and maintain. Larger assemblies are attached to the nodal points. Instruments weighing less than 220 lbs (100 kg) are assembled on standard equipment support panels similar to those on a Spacelab pallet.

Thermal Control

Thermal control for EURECA combines active and passive heat transfer and radiation systems. Active transfer, required for payload facilities which generates more heat, is achieved by means of a freon cooling loop which dissipates the thermal load through two radiators into space. The passive system makes use of multilayer insulation blankets combined with electrical heaters. During nominal operations, the thermal control subsystem rejects a maximum heat load of about 2300 W.

Electrical Power

The electrical power subsystem generates, stores, conditions and distributes power to all the spacecraft subsystems and to the payload. The deployable and retractable solar arrays, with a combined raw power output of some 5000 W together with four 40 Ah nickel-cadmium batteries, provide the payload with a continuous power of 1000 W, nominally at 28 V, with peak power capabilities of up to 1500 W for several minutes.

Attitude and Orbit Control

A modular attitude and orbit control subsystem (AOCS) was used for attitude determination and spacecraft orientation and stabilization during all flight operations and orbit control maneuvers.

An orbit transfer assembly, consisting of two redundant sets of four thrusters was used to boost EURECA to its operation attitude at 500 km and to return it to its retrieval orbit at about 300 km.

EURECA has been developed under ESA contract by DASA (Deutsche Aerospace/ERNO Raumfahrttechnik) (Germany), and their subcontractors Sener (Spain), AIT (Italy), SABCA (Belgium), AEG (Germany), Fokker (The Netherlands), Matra (France), Snia BPD (Italy), BTM (Belgium) and Laben (Italy).

EURECA SCIENCE

Solution Growth Facility - a multi-user facility dedicated to the growth of monocrystals from solution, consisting of a set of four reactors and their associated control system.

Protein Crystallization Facility - a multi-user solution growth facility for protein crystallization in space. The object of the experiments is the growth of single, defect-free protein crystals of high purity and of a size sufficient to determine their molecular structure by x-ray diffraction.

Exobiology and Radiation Assembly - a multi-user life science facility for experiments on the biological effects of space radiation.

Multi-Furnace Assembly - a multi-user facility dedicated to material science experiments. It is a modular facility with a set of common system interfaces which incorporates 12 furnaces of three different types, giving temperatures of up to 1400 degrees C.

Automatic Mirror Furnace - an optical radiation furnace designed for the growth of single, uniform crystals from the liquid or vapor phases, using the traveling heater or Bridgman methods.

Surface Forces Adhesion Instrument - studies the dependence of surface forces and interface energies on physical and chemical-physical parameters such as surface topography, surface cleanliness, temperature and the deformation properties of the contacting bodies.

High Precision Thermostat Instrument - an instrument designed for long term experiments requiring microgravity conditions and high precision temperature measurement and control.

Solar Constant And Variability Instrument - designed to investigate the solar constant, its variability and its spectral distribution, and measure:

- fluctuations of the total and spectral solar irradiance
- short term variations of the total and spectral solar irradiance within time scales ranging from hours to few months, and
- long term variations of the solar luminosity in the time scale of years (solar cycles) by measuring the absolute solar irradiance.

Solar Spectrum Instrument - designed to study solar physics and the solar-terrestrial relationship in aeronomy and climatology. It measures the absolute solar irradiance and its variations in the spectral range from 170 to 3200 nm, with an expected accuracy of 1 percent in the visible and infrared ranges and 5 percent in the ultraviolet range.

Occultation Radiometer Instrument - designed to measure aerosols and trace gas densities in the Earth's mesosphere and stratosphere.

Wide Angle Telescope - designed to detect celestial gamma and X-ray sources with photon energies in the range 5 to 200 keV and determine the position of the source.

Timeband Capture Cell Experiment - an instrument to study the microparticle population in near-Earth space -- typically Earth debris, meteoroids and cometary dust.

Radio Frequency Ionization Thruster Assembly - designed to evaluate the use of electric propulsion in space and to gain operational experience before endorsing its use for advanced spacecraft technologies.

Advanced Solar Gallium Arsenide Array - to provide valuable information on the performance of gallium arsenide (GaAs) solar arrays and on the effects of the low Earth orbit environment on their components.

GET AWAY SPECIAL EXPERIMENTS

NASA's Get Away Special (GAS) program, managed by the Goddard Space Flight Center (GSFC), Greenbelt, Md., is a vehicle that allows the world to get involved in the U.S. space program. Individuals and organizations of all countries have gained access to space by sending scientific research and development experiments onboard the Space Shuttle via the GAS program. Since its inception, 87 payloads have flown on 18 Space Shuttle missions.

NASA's GAS bridge assembly, a structure which fits across the payload bay of the Space Shuttle orbiter, is capable of holding up to 12 GAS cannisters (or cans), and offers an efficient and convenient way to fly multiple payloads simultaneously.

On STS-57, the GAS bridge is flying with a total of 10 GAS payloads from the U.S., Canada, Japan and Europe. Also on the bridge is one secondary payload, a commercialization experiment sponsored by the Consortium for Materials Development in Space at the University of Alabama, Huntsville and one GAS ballast can. Clarke Prouty is GAS Mission Manager and Lawrence R. Thomas is Customer Support Manager for the Shuttle Small Payloads Project at Goddard. The 10 GAS payloads are:

G-022 Liquid Gauging Technology Experiment

Customer: European Space Agency, European Space Research and Technology Centre, Noordwijk, The Netherlands

Customer Manager: Manfred Trischberger
NASA Technical Manager: Richard Hoffman, GSFC

This experiment demonstrates two in-orbit methods of gauging liquids in tanks - the Periodic Volume Stimulus (PVSM) and the Foreign Mass Injection Method (FMIM).

Both approaches work well in the presence of gravity, but the peculiar properties of liquid under microgravity conditions could lead to a lower measurement accuracy. This experiment will study, in particular, errors caused by the following effects:

- liquid distribution in the tank
- unconnected liquid quantities
- uneven heating
- unintentional intrusion of fluid in pipes, sensor apertures, etc.

G-324 CAN DO

Customer: Charleston County School District, Charleston, S.C.
Customer Manager: Carol A. Tempel
NASA Technical Manager: Neal Barthelme, GSFC

A detailed description of G-324 CAN DO is available in the educational activities part of the STS-57 press kit.

G-399 Insulin Tagging and Artemia Growth Experiments

Customer: Dr. Ronald S. Nelson, Inc., Fresno, Calif.
Customer Manager: Dr. Ronald S. Nelson
NASA Technical Manager: Gary Sneiderman, GSFC

This payload is composed of two experiments. Its primary objective is to successfully operate an insulin tag experiment and a brine shrimp Artemia physiology experiment. The experiments also will focus on educating students about all aspects of carrying out scientific experiments.

G-450 Multiple Experiments

Customer: Vandenberg Section, American Institute of Aeronautics and Astronautics, Vandenberg AFB, Calif.
Customer Manager: Martin Waldman
NASA Technical Manager: Mark Anderson, GSFC

This is a multidisciplinary package composed of six self-contained modules, each containing multiple experiments. The experiments are designed and developed by California Central Coast elementary, middle and high schools.

- Module one contains solidification/crystallization of saccharin and cryogen transfer.

- Module two addresses the effects of radiation on bacteria and effects of microgravity on sprouting seeds.

- Module three is bacteria survival in radiation and zero point energy.

- Module four consists of electrode occlusion and bubble formation and microgravity bonding.

- Module five contains osmosis, reverse osmosis and effects of radiation on seeds.

- Module six is crystal growth, fluids in microgravity and silver crystal growth.

G-452 Crystal Growth of Gallium-Arsenide

Customer: Society of Japanese Aerospace Companies, Tokyo, Japan
Customer Manager: Dr. Naotake Tateyama
NASA Technical Manager: Herb Foster, GSFC

This GAS can consists of 12 small electric furnaces. The four kinds of experiments to be carried out in low gravity are:

- Growth of a single crystal gallium-arsenide from liquid phase
- Growth of a crystal gallium-arsenide based mixed crystal
- Addition of a heavy element to gallium-arsenide
- Addition of a heavy element to indium-antimony crystal

G-453 Semi-Conductors/Superconductor Experiment

Customer: Society of Japanese Aerospace Companies, Tokyo, Japan
Customer Manager: Dr. Naotake Tateyama
NASA Technical Manager: Herb Foster, GSFC

This GAS can contains four different kinds of experiments. Three of the four are materials experiments on semi-conductors and a superconductor, and the other is on boiling an organic solvent under weightlessness.

G-454 Crystal Growth

Customer: Society of Japanese Aerospace Companies, Tokyo, Japan
Customer Manager: Dr. Naotake Tateyama
NASA Technical Manager: Herb Foster, GSFC

This experiment studies the crystal growth of indium gallium arsenic from vapor phase under weightlessness, the crystal growth of three selenic-niobium from vapor phase, the crystal growth of an optoelectric crystal by the diffusion method and formation of superferromagnetic alloy.

G-535 The Pool Boiling Experiment

Customer: NASA Headquarters, Office of Space Science and Applications, Microgravity Sciences Division, Washington, D.C.
Customer Manager: Warren Hodges
NASA Technical Manager: Tom Dixon, GSFC

The objective of this experiment is to improve the understanding of the boiling process. This involves putting a pool of liquid in contact with a surface that can supply heat to the liquid. The experiment will observe heating and vapor bubble dynamics associated with bubble growth/collapse and subsequent bubble motion. The lack of gravity driven motion makes the boiling process easier to study in microgravity.

G-601 High Frequency Variations of the Sun

Customer: San Diego Section, American Institute of Aeronautics and Astronautics, San Diego, Calif.
Customer Manager: Brian Dubow
NASA Technical Manager: Neal Barthelme, GSFC

This experiment will measure and analyze high-frequency variations of the Sun analyzing light that the Sun releases to the Earth. It also will determine better the physics of the Sun and other stars. The primary purpose of the experiment involves measuring rapid variations in the solar flux.

G-647 Configurable Hardware for Multi-Disciplinary Projects in Space (CHAMPS)

Customer: Canadian Space Agency, Ottawa, Ontario, Canada
Customer Manager: Duncan Burnside
NASA Technical Manager: Russ Griffin, GSFC

This is a versatile payload that will provide an inexpensive means for Canadian scientists to conduct their materials science experiments in space. CHAMPS, built by MPB Technologies in Montreal, is designed to be adaptable, combining the advantages of generic and dedicated research facilities for materials processing in space. This experiment will examine a recently-developed technique for crystal growth called Liquid Phase Electro-Epitaxy (LPEE) in a microgravity environment. LPEE regulates crystal growth by passing an electrical current through a subject material.

GAS Ballast Payload

Customer: Goddard Space Flight Center, Greenbelt, Md.

GAS ballast payloads are flown for stability when a GAS payload drops out and no GAS payload is available to replace it. This ballast payload contains a small accelerometer package furnished by Goddard to record accelerations during the mission.

Sample Return Experiment

Jet Propulsion Laboratory, Pasadena, Calif.
Principal Investigator: Dr. Peter Tsou

The Sample Return Experiment (SRE) sits on top the ballast GAS can. The primary science objective of the GAS SRE is the quantification of extraterrestrial particles and other orbital debris present in the orbiter bay. A secondary objective of this experiment will be a realistic test for comet sample collection concepts. The sample particles that are to be encountered and collected have speeds of 10-14 km/second (16-22 m.p.h.) and diameters of 10-200 micrometers.

Consortium for Materials Development in Space Complex Autonomous Payload

The Consortium for Materials Development in Space Complex Autonomous Payload-IV (CONCAP-IV) is a small, Shuttle cargo bay payload sponsored by the University of Alabama in Huntsville (UAH) Consortium for Materials Development in Space (CMDS). The CMDS is one of the NASA Centers for the Commercial Development of Space (CCDS) managed by NASA's new Office of Advanced Concepts and Technology (OACT).

CONCAP-IV is the fourth area of investigation in a series of payloads deriving their name from the consortium in CMDS and the Complex Autonomous Payload (CAP) program managed by the NASA Goddard Space Flight Center. On STS-57, CONCAP-IV will investigate the growth of nonlinear organic (NLO) crystals by a novel method of physical vapor transport in the weightlessness of the space environment.

Nonlinear optical materials are the key to many optical applications now and in the future -- optical computing is a prime example. Many studies have suggested that the photonics industry ultimately will grow to the scale of the current electronics industry. Just as materials improvements in silicon were essential to electronics, so too are improved optical materials required for advanced in photonics. The investigations in the CONCAP series seek to determine whether crystals grown in space can speed the evolution of photonics.

During the experiment, it is anticipated that the microgravity in space will facilitate two goals of improved NLO crystal growth -- it will avoid convection, leading to crystals grown with more uniform composition, and it will avoid the deformation of the crystals under their own weight at the relatively high growth temperatures where they are extremely soft.

The experiment operation involves heating up a chamber containing the material needed to produce the crystal, but keeping one spot on the chamber walls cooler than the rest of the chamber walls. This method causes the vapor of the material to condense onto the cold spot where the crystal grows, much like water vapor condenses into dew on grass.

Within CONCAP-IV there are six NLO "ovens," each containing two NLO growth cells. Each of the twelve cells is comprised of a glass chamber, about 1 inch in diameter and 2 inches long and contains the sample material to be processed. Each cell is wrapped in a heater. Within each cell is a small copper plug that is kept slightly cooler than the rest of the cell, providing a place for sample material vaporized by the heater to recondense and grow the desired crystal or thin film material.

The "ovens" are constructed from two aluminum cylinders, one inside the other, with the area between them vented to space to form an insulating vacuum -- like a thermos bottle. The resulting reduction in heat loss is a very important consideration since CONCAP-IV is battery-operated, providing a limited power supply. The high and low temperatures in each chamber are controlled by a miniaturized computer designed and built specially for this purpose.

The crystals being grown have two important properties. First, when a laser beam passes through the crystal it comes out with twice the frequency (half the wavelength) of the original beam. This is important because it doubles the range of frequencies available for laser applications. Currently, lasers only operate efficiently at a limited number of frequencies, with some very important frequencies missing for scientific and commercial applications.

Second, when an electric field is applied to some NLO materials, the refractive index of the material changes. When the refractive index changes, so does the path of light traveling through the crystal. This is like having a prism which will bend a light beam different degrees when voltages are applied to the crystal. The changing of the path of a light beam results in the crystals or thin film acting as a high speed, nearly instantaneous switch.

Such properties are extremely important to the optoelectronics and photonics industry, especially for optical computing. Without NLO materials, optical computers would be impossible. Nonlinear optical materials could play the same role in photonics and optoelectronics that semiconductors do in the electronics industry.

Displaytech, Inc., Boulder, Colo., is participating with the UAH CMDS in CONCAP-IV. Displaytech is a commercializer of high-performance electro-optical devices. The Principal Investigator is Dr. Thomas Leslie, Associate Professor, Chemistry Department, UAH. The Payload Manager is William Carswell, Research Associate, UAH.

Superfluid Helium On-Orbit Transfer (SHOOT) Flight Demonstration

The Superfluid Helium On-Orbit Transfer (SHOOT) Flight Demonstration, managed by NASA's Goddard Space Flight Center, is an experiment designed to develop and demonstrate the technology required to resupply liquid helium containers in space. In addition, components developed for SHOOT may find use in future space cryogenic (low temperature) systems.

Many detectors for astrophysics and observation of Earth require cooling to extremely low temperatures to achieve high sensitivity. To achieve these low temperatures, liquid helium is used for cooling. By allowing the liquid to slowly vaporize, an instrument may be cooled to temperatures below 2 Kelvin (K) (-519° F, -271° C).

Examples of facilities that already have flown using liquid helium are the Infrared Astronomy Satellite (IRAS), launched in 1983, which discovered more than a quarter million new infrared objects and the Cosmic Background Explorer (COBE), launched in 1989, which has studied the Big Bang, the primeval explosion that started the expansion of the universe.

The liquid helium gradually vents to space as it cools the instruments, therefore the instrument has a finite lifetime. It takes only a small amount of heat to evaporate liquid helium. For example, a 100 watt light bulb left on in a 53 gallon (200 liter) dewar would evaporate all the liquid in less than 1.5 hours. Both IRAS and COBE ran out of liquid in 10 to 11 months of operation.

To achieve lower temperatures in the liquid, the vapor pressure is lowered. On the ground, this is accomplished by powerful vacuum pumps. In orbit, this is achieved by venting to the vacuum of space. By doing this, IRAS achieved a temperature of 1.64 K and COBE a temperature of 1.37 K. By contrast, cold, deep space is a relatively warm 2.74 K, twice as warm as COBE's liquid helium. Thus, COBE was the coldest known object in the universe outside of the Earth's atmosphere. SHOOT is expected to set a new low temperature record at 1.1 K.

The SHOOT experiment consists of two vacuum insulated Thermos®-like containers, called dewars, each holding 55 gallons (207 liters) of liquid helium. The two dewars are connected by a vacuum insulated transfer line. Liquid helium is pumped from one dewar to another at rates from 1.3 to 4.4 gallons per minute (300 to 1000 liters per hour). Each of dewar's plumbing, including pumps, valves and instrumentation, is nearly identical so that each dewar in turn may act as the supply or receiver dewar.

The SHOOT dewars are attached to a Hitchhiker bridge which spans the width of the orbiter bay. The SHOOT electronics interface to the Shuttle through the Hitchhiker avionics.

Having no viscosity, superfluid helium will leak through the smallest hole. Because the space around the cryogen tank must be a very good vacuum to insulate the liquid, no leak of any size can be tolerated. A leak at room temperature would be approximately 10,000 times greater with superfluid helium. Even an air leak which is so small that it would take 20 million years to fill the dewar is unacceptable. SHOOT has approximately 160 welds and 60 removable metal seals between the superfluid and the vacuum space. All of these have been checked and shown to be absolutely leak tight.

SHOOT will consist of experiments in liquid management in low gravity, filling a large gap in the knowledge of the behavior of cryogens in space. The problem of controlling the position of cryogenic liquids in orbit is a difficult one. The evaporating gas must be allowed to leave the dewar, but the liquid must be contained. On the ground this is easy since the liquid is denser than the gas and gravity holds it in the bottom of the tank. In a low gravity environment, the liquid location is not well defined. Surface tension, heat inputs and the small residual accelerations of a spacecraft all play a role in positioning the liquid.

SHOOT will accomplish the first active management of liquid cryogens in space. A device called a phase separator allows helium vapor to leave the tank while the liquid is retained. The liquid will be gathered from the walls of the tank and fed to a superfluid pump. This pump converts heat directly to pressure by an effect unique to superfluid helium called the fountain effect.

SHOOT is part experiment and part demonstration. Because so little experience with cryogen management in low gravity exists, the first part of SHOOT's on-orbit operations will be to gather as much data as possible about how the liquid is delivered to the pumps by liquid acquisition devices, the behavior of the liquid/vapor discriminators and the slosh and cooldown of the liquid. Control of the experiment will be from the ground through the Payload Operations Control Center at Goddard with the astronauts monitoring from the Shuttle's aft flight deck at key times.

At one point the astronauts will accelerate the orbiter to settle the liquid in one end of the dewar to calibrate sensors. During two transfers, the Shuttle will be accelerated to move the liquid away from the pump to see if such disturbances interupt the flow. Once the transfer of liquid stops, the acceleration will be stopped and the return of the liquid to the pump will be monitored.

Near the end of the operations, the astronauts will control a transfer completely from the aft flight deck. They will use a program which has some expert system capabilities to control the transfer and diagnose any problems which may occur. This will be the first use of an expert system for a payload on the orbiter.

SHOOT was developed and managed by Goddard for NASA's Office of Space Systems Development, Advanced Program Division, Washington, DC.

SHOOT will:

- achieve the lowest temperature ever in orbit -- 1.1 K (-457° F, 1.1 degrees above absolute zero).
- demonstrate the first active management of liquid cryogen in space.
- demonstrate the first use of an expert system in space.
- demonstrate two types of liquid acquisition systems for delivering liquid to the pump.
- make the first observations of thermal layering and mixing of a cryogen in orbit.
- demonstrate superfluid mass gauging to 1 percent accuracy.
- demonstrate controlled cooldown of a warm dewar.

SHOOT spinoff technologies include:

- Cryogenic motor driven valves are leak tight after hundreds of cycles.
- A liquid/gas phase separator for use with normal liquid helium as well as superfluid, enabling easier ground servicing of future small dewars.

- Liquid/vapor discriminators which can be used for other cryogens as well as liquid helium.
- A relatively simple thermometry system to obtain resolution of 0.00001 K or better.

STS-57 EXTRAVEHICULAR ACTIVTY: DETAILED TEST OBJECTIVE 1210

STS-57 crew members David Low and Jeff Wisoff will perform a 4-hour extravehicular activity (EVA) on the fifth day of the flight as a continuation of a series of spacewalks NASA plans to conduct to prepare for the construction of the space station.

STS-57 will be launched as a 6-day, 22-hour, 40-minute flight. After launch, if calculations of the amount of fuel and energy required to retrieve EURECA and operate Spacehab match preflight projections, the flight will be extended by 24 hours. The EVA is the lowest priority of any objective or experiment on the flight, and the spacewalk will be performed only if the flight is extended by one day to become about a 7-day, 23-hour flight.

The space station demonstration EVAs, the first of which was performed on STS-54 in January 1993, are designed to refine training methods for spacewalks, expand the EVA experience levels of astronauts, flight controllers and instructors, and aid in better understanding the differences between true microgravity and the ground simulations used in training.

In addition, since the Shuttle's remote manipulator system (RMS) mechanical arm will be aboard Endeavour to retrieve EURECA, the STS-57 spacewalk will assist in refining several procedures being developed to service the Hubble Space Telescope on mission STS-61 in December 1993.

Low will be designated extravehicular crew member 1 (EV1) and Wisoff will be designated extravehicular crew member 2 (EV2). Pilot Brian Duffy will serve as intravehicular crew member 1 (IV1), assisting the spacewalkers from inside the crew cabin of Endeavour.

During the spacewalk, Low and Wisoff first will take turns in a foot restraint mounted on the end of the robot arm, holding their fellow crew member in various ways to imitate moving a large, inanimate piece of equipment. Next, they will investigate different methods of managing their safety tethers while mounted in the robot arm restraint.

Another objective is planned to have each crew member, mounted in the robot arm restraint, practice aligning their fellow crew member into a foot restraint mounted on the side of the cargo bay, simulating the task of aligning a large object into a tightly fitting restraint. The crew members also will practice working with various tools while in the robot arm restraint and gauge the ability of the restraint to hold them steady as they tighten or loosen a bolt.

The information gathered by these tests is expected to apply to both the HST servicing spacewalks and space station construction planning, since moving, aligning and installing objects with large masses from the end of the robot arm will be integral to both jobs.

Among the items hoped to be better determined are the speed at which the arm can be moved while an astronaut holds an object on the end, how large an object it is feasible to handle while in the arm foot restraint, the amount of time required for such tasks using an EVA crew member and the arm and how much stability is supplied by the arm during hands-on work such as tightening bolts and other attachment equipment.

FLUID ACQUISITION AND RESUPPLY EXPERIMENT II

Principal Investigator: Susan L. Driscoll
Marshall Space Flight Center, Huntsville, Ala.

The Fluid Acquisition and Resupply Experiment (FARE II) will investigate the dynamics of fluid transfer in microgravity. The experiment previously flew as FARE I on STS-53 in 1992 and also as the Storable Fluid Management Demonstration (SFMD) on STS 51-C in 1985.

In space, liquid in a container does not readily settle on the bottom or leave a pocket of gas on top as it does on Earth. The position of liquids in weightlessness is highly unpredictable because the liquid and gas may locate or mix in any area within the container. To replenish on-board fluids and prolong the life of space vehicles such as the space station, satellites and extended duration orbiters, methods for transferring gas-free propellants and other liquids must be developed.

FARE I was conducted primarily to assess the ability of a screen channel capillary system to drain liquids while working in a microgravity environment. Additionally, some experimentation was conducted regarding the control of liquid motion during tank refill sequences.

Housed in four middeck lockers of the orbiter Endeavour, FARE II is designed to demonstrate the effectiveness of a device to alleviate the problems associated with vapor-free liquid transfer. The device exploits the surface tension of the liquid to control its position within the tank.

The basic flight hardware consists of a 12.5 inches (30.48 cm) spherical supply tank and a 12.5 inches (30.48 cm) spherical receiver tank made of transparent acrylic. Additional items include liquid transfer lines, two pressurized air bottles, a calibrated cylinder and associated valves, lines, fittings, pressure gauges and a flowmeter display unit.

The experiment is essentially self-contained, with the exception of a water-fill port, air-fill port and an overboard vent connected to the orbiter waste management system.

Mission specialists will conduct this experiment eight times during the flight, using a sequence of manual valve operations. Air from the pressurized bottles will be used to force fluid from the supply tank to the receiver tank and back to the supply tank. This process should take about 1 hour each time it is performed. An overboard vent will remove the vapor from the receiver tank as the fluid level rises.

The FARE II control panel, containing four pressure gauges and one temperature control gauge, will be used by the crew to monitor and control the experiment. Camcorder video tapes and 35-mm photographs will be made during the transfer process. The crew also will have the option of using air-to-ground communication to consult with the principal investigator, if necessary.

The test fluid used for this experiment is water with iodine, used as a disinfectant; blue food coloring, which will allow better visibility of the liquid movement; a wetting solution, known as Triton X-100, to give the fluid the consistency of a propellant; and an anti-foaming emulsion agent to prevent bubbles from forming in the receiver tank.

Post-mission analysis of FARE II will include evaluation of the experiment equipment, as well as review of camcorder video tapes and 35-mm photographs. Because there will be no real-time data downlink during this experiment, detailed study and analysis of test data will not be conducted until after the mission.

Historically, problems dealing with fluid orbital transfer have been dealt with by using bellows to move liquid without any pressurant gas or vapor surface. These systems are heavier, more complex, more expensive and more prone to leakage during the transfer process than conventional methods of liquid containment, such as the FARE II equipment.

The mission managed by NASA's Marshall Space Flight Center, Huntsville, Ala., will utilize equipment developed by Martin Marietta. At Marshall, Susan L. Driscoll is the Principal Investigator for FARE II.

Air Force Maui Optical System

The Air Force Maui Optical System (AMOS) is an electrical-optical facility on the Hawaiian island of Maui. No hardware is required aboard Endeavour to support the experimental observations. The AMOS facility tracks the orbiter as it flies over the area and records signatures from thruster firings, water dumps or the phenomena of "Shuttle glow," a well-documented fluorescent effect created as the Shuttle interacts with atomic oxygen in Earth orbit. The information obtained by AMOS is used to calibrate the infrared and optical sensors at the facility.

STS-57 SPECIAL EVENTS & EDUCATIIONAL ACTIVITIES

Get-Away-Special #324 -- CAN DO

The Charleston County School District's CAN DO experiment (GAS #324) is designed to take 1,000 photos of the Earth allowing students to make observations and document global change by comparing the CAN DO photos with matched Skylab photos. The canister also contains 350 small passive student experiments. CAN DO is sponsored by NASA's Langley Research Center, Hampton, Va., and supported by the South Carolina Space Grant Consortium.

The CAN DO payload uses GAS hardware and is housed in a 5 cubic foot canister. The canister is sealed with a 0.92 inch fused silica window, which is optically flat and ground to a quarter wave tolerance, permitting photography in visible light, infrared and ultraviolet wavelengths.

The primary payload of CAN DO, known as GEOCAM, contains four Nikon 35-mm cameras equipped with 250 exposure film backs. The GEOCAM system will match closely the larger Skylab film format in both coverage and quality allowing direct examination and comparison of the changes that have occurred to the planet in the last 20 years.

One thousand photographs will be taken by the four cameras over the course of the Shuttle mission. Photographic targets will be chosen by teachers and students based on weather, Sun angle, orbiter orientation and crew activities. Targets selected will be sent to the Shuttle once a day as crew notes.

These efforts will be managed through a student-run mission control room at the Medical University of South Carolina. Student-teacher teams of 12 to 20 will operate four desks monitoring crew activities and mission timeline, monitoring weather data, targeting geological or environmental interests and communicating the target objectives with NASA's Johnson Space Center's Earth Observations Lab and the Shuttle Small Payload Customer Support Room.

Activities and reports from the control room will be televised to students throughout the state by the South Carolina Educational Television Network. The Medical University of South Carolina will provide technical assistance.

The CAN-DO teachers have designed classroom activities for grades K-12 using the 1,000 photos to make observations. The photos comprise the first educational payload to photograph the Earth from space. Students will search for natural and human-induced environmental changes that may have taken place during the past 20 years. Comparison between the photos, past and present, enables students to discover for themselves the major effects caused by deforestation, urbanization, river sediment loads, desertification, coastal erosion, lake levels wetlands and pollution.

With assistance from atmospheric scientists, the photos should provide clues to the degradation of the air quality often mentioned by astronauts. Faculty members of the College of Charleston will aid in the interpretation of the results.

The second experiment carried on CAN DO is 350 student-designed experiments. No other GAS payload in the history of the space program has ever undertaken this many different experiments. These experiments have been submitted from more than 60 Charleston County classrooms and from invited school districts from Maryland, Virginia, Texas, Arizona and Massachusetts.

These experiments allow students to participate directly in research by testing the effect of space on various materials. Students from K-12 have chosen materials ranging from brine shrimp eggs to bubble solution to lipstick to cotton seeds to fly in space. A major goal of the student experiments is to teach the skills of proper experimental design as well as execution of valid scientific experiments.

Each student team has five samples of their materials in small 5 ml cryovials: one to fly in space, one to serve as a passive control and one each to be exposed to high doses of radiation, extreme cold and centrifuge. The control procedures will be carried out at the Medical University of South Carolina as part of its Business/Education Partnership Program with the Charleston County School District Office of Math, Sciences and Technology.

In addition to the students' vial experiments, the WESTVACO Forestry Division has donated Sycamore and Loblolly Pine seeds to be placed into the canister. Classes participating in CAN DO will receive seedlings grown from space-exposed seeds and encouraged to raise "space trees."

Students and teachers from the Poquoson School District in Poquoson, Va., are participating in the payload's student-designed experiments. Also, a team of Poquoson secondary students will travel to Charleston and operate the weather desk at the student mission control. NASA Langley atmospheric research scientists will provide appropriate training to the Poquoson students for their weather desk assignment.

Shuttle Amateur Radio Experiment-II

The Shuttle Amateur Radio Experiment-II (SAREX-II) provides for public participation in the space program, supports educational initiatives and demonstrates the effectiveness of making contact between the Space Shuttle and low-cost amateur "ham" radio stations on the ground.

On STS-57, Pilot Brian Duffy, call sign N5WQW, and Janice Voss, call sign to be determined, will operate SAREX. Duffy has operated SAREX in flight before during Shuttle mission STS-45. Operating times for school contacts are planned into the crew's activities. The school contacts generate interest in science as students talk directly with Voss or Duffy. There will be voice contacts with the general ham operator community as time permits. and short wave listeners (SWL's) worldwide also may listen. When Voss or Duffy are not available. SAREX-II will be in an automated digital response mode.

On STS-57, SAREX-II will include VHF FM voice and VHF packet. The primary voice frequency that SAREX-II uses is 145.55 MHz downlink. There are a variety of uplink frequencies. Contacts with Endeavour will be possible between 42 degrees north latitude to 42 degrees south latitude, covering the lower half of the continental United States and Hawaii, all of Africa, most of South America, Australia, the East and the Far East.

SAREX has flown previously on STS-9, STS-51F, STS-35, STS-37, STS-45, STS-50, STS-47, STS-55 and STS-56. SAREX is a joint effort of NASA, the American Radio Relay League (ARRL), the Amateur Radio Satellite Corp. (AMSAT), and the Johnson Space Center's Amateur Radio Club. Information about orbital elements, contact times, frequencies and crew operating schedules will be made available during the mission by these agencies and by amateur radio clubs at some other NASA centers.

Hams from the JSC club, W5RRR, will be operating on amateur short wave frequencies, and the ARRL station, W1AW, will include SAREX information in its regular voice and teletype bulletins. The amateur radio station at the Goddard Space Flight Center, WA3NAN, in Greenbelt, Md., will operate around-the-clock during the mission, providing information and re-transmitting live Shuttle air-to-ground audio. The JSC Public Affairs Office will operate a SAREX information desk during the mission, and mission information also will be available on the dial-up computer bulletin board (BBS) at JSC.SAREX Frequencies.

	Shuttle Transmitting Frequency	Shuttle Receiving Frequency
U.S.	145.55 MHz	144.99 MHz
South America	145.55	144.97
& Asia	145.55	144.95
	145.55	144.93
	145.55	144.91
Europe	145.55 MHz	144.70 MHz
	145.55	144.75
	145.55	144.80
South Africa	145.55 MHz	144.95 MHz
Packet	145.55	144.49

GSFC Amateur Radio Club (WA3NAN) planned HF operating frequencies

3.860 MHz	7.185 MHz
14.295 Mhz	21.395 MHz
28.395 Mhz	

To connect to the JSC Compute Bulletin Board, BBS, (8 N 1 1200 baud) dial 713/483-2500 then type 62511.

STS-57 CREW BIOGRAPHIES

Ronald J. Grabe, 47, Col., USAF, will be Commander (CDR) of STS-57. Selected as an astronaut in August 1981, Grabe considers New York, N.Y., his hometown and will be making his fourth space flight.

Grabe graduated from Stuyvesant High School, New York, in 1962. He received a bachelors degree in engineering from the United States Air Force Academy in 1966 and studied aeronautics as a Fulbright Scholar at the Technische Hochschule, Darmstadt, West Germany in 1967.

Grabe first flew as Pilot for Shuttle mission STS-51J in October 1985. On his second flight, he was Pilot for Shuttle mission STS-30 in May 1989. On his most recent flight he was Commander of Shuttle mission STS-42 in January 1992. Grabe has logged more than 387 hours in space.

Brian Duffy, 39, Col., USAF, will serve as Pilot (PLT). Selected as an astronaut in June 1985, Duffy was born in Boston, Mass., and will be making his second space flight.

Duffy graduated from Rockland High School, Rockland, Mass., in 1971. He received a bachelors degree in mathematics from the Air Force Academy in 1975 and a masters degree in systems management from the University of Southern California in 1981.

Duffy first flew as Pilot of STS-45 in March 1992 and has logged more than 214 hours in space.

G. David Low, 37, will serve as Payload Commander and Mission Specialist 1 (MS1). Selected as an astronaut in May 1984, Low was born in Cleveland and will be making his third spaceflight.

Low graduated from Langley High School, McLean, Va., in 1974. He received a bachelors degree in physics-engineering from Washington and Lee University in 1978, a bachelors degree in mechanical engineering from Cornell University in 1980 and a masters degree in aeronautics and astronautics from Stanford University in 1983.

Low first flew as a mission specialist aboard STS-32 in January 1990. His next flight was as a mission specialist on STS-43 in August 1991. He has logged more than 474 hours in space.

Nancy Jane Sherlock, 34, Capt., USA, will serve as Mission Specialist 2 (MS2). Selected as an astronaut in January 1990, Sherlock considers Troy, Ohio, her hometown and will be making her first space flight.

Sherlock graduated from Troy High School in 1977. She received a bachelors degree in biological science from Ohio State University in 1980 and a masters degree in safety engineering from the University of Southern California in 1985.

After serving as a Neuropathology Research Assistant for 3 years at the Ohio State University College of Medicine, Sherlock was commissioned in the U. S. Army in 1981. She attended the Army Aviation School and later served as a UH-1H instructor pilot and a standardization instructor pilot for all phases of rotary wing flight. She has logged more than 2,900 hours flying time in rotary wing and fixed wing aircraft.

Sherlock was assigned to NASA as a flight simulation engineer on the Shuttle Training Aircraft at the Johnson Space Center in 1987, developing and directing engineering flight tests, a position she held at the time of her selection.

Peter J. K. (Jeff) Wisoff, 34, will serve as Mission Specialist 3 (MS3). Selected as an astronaut in January 1990, Wisoff was born in Norfolk, Va., and will be making his first space flight.

Wisoff graduated from Norfolk Academy in 1976. He received a bachelors degree in physics from the University of Virginia in 1980, a masters degree in applied physics from Stanford University in 1982 and a doctorate in applied physics from Stanford in 1986.

After completing his doctorate, Wisoff joined the Rice University faculty in the Electrical and Computer Engineering Department, researching the development of new vacuum ultraviolet and high intensity laser sources and the medical application of lasers to the reconstruction of damaged nerves. He is currently collaborating with researchers at Rice University on developing new techniques for growing and evaluating semiconductor materials using lasers.

Janice Voss, 36, will serve as Mission Specialist 4 (MS4). Selected as an astronaut in January 1990, Voss considers Rockford, Ill., her hometown and will be making her first space flight.

Voss graduated from Minnechaug Regional High School in Wilbraham, Mass., in 1972. She received a bachelors degree in engineering science from Purdue University in 1975, a masters degree in electrical engineering from the Massachusetts Institute of Technology (MIT) in 1977 and a doctorate in aeronautics and astronautics from MIT in 1987.

Voss was a cooperative education employee at the Johnson Space Center from 1973 to 1975, working with computer simulations in the Engineering and Development Directorate. In 1977, she returned to JSC to work as a crew trainer, teaching entry guidance and navigation. After completing her doctorate, she joined Orbital Sciences Corp., working on mission integration and flight operations support for the Transfer Orbit Stage, a position she held at the time of her selection.

STS-57 MISSION MANAGEMENT

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Robert Weaver - Chief, Special Payloads Division
David Shrewsberry - Associate Chief, Special Payloads Division

SHUTTLE FLIGHTS AS OF APRIL 1993

55 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM - 30 MISSIONS CONDUCTED SINCE RETURN TO FLIGHT.

	OV-099 CHALLENGER	OV-102 COLUMBIA	OV-103 DISCOVERY	OV-104 ATLANTIS	OV-105 ENDEAVOUR
			STS-56 04/08/93 - 04/17/93		
15			STS-53 12/2/92 - 12/9/92		
14		STS-55 04/26/93 -	STS-42 01/22/92 - 01/30/92		
13		STS-52 10/22/92 - 11/1/92	STS-48 09/12/91 - 09/18/91		
12		STS-50 06/25/92 - 07/09/92	STS-39 04/28/91 - 05/06/91	STS-46 7/31/92 - 8/8/92	
11		STS-40 06/05/91 - 06/14/91	STS-41 10/06/90 - 10/10/90	STS-45 03/24/92 - 04/02/92	
10	STS 51-L 01/28/86	STS-35 12/02/90 - 12/10/90	STS-31 04/24/90 - 04/29/90	STS-44 11/24/91 - 12/01/91	
09	STS 61-A 10/30/85 - 11/06/85	STS-32 01/09/90 - 01/20/90	STS-33 11/22/89 - 11/27/89	STS-43 08/02/91 - 08/11/91	
08	STS 51-F 07/29/85 - 08/06/85	STS-28 08/08/89 - 08/13/89	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91	
07	STS 51-B 04/29/85 - 05/6/85	STS 61-C 01/12/86 - 01/18/86	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90	
06	STS 41-G 10/5/84 - 10/13/84	STS-9 11/28/83 - 12/08/83	STS 51-I 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90	
05	STS 41-C 04/06/84 - 04/13/84	STS-5 11/11/82 - 11/16/82	51-G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89	
04	STS 41-B 02/03/84 - 02/11/84	STS-4 06/27/82 - 07/04/82	51-D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89	
03	STS-8 08/30/83 - 09/05/83	STS-3 03/22/82 - 03/30/82	STS 51-C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88	STS-54 01/13/93 - 01/19/93
02	STS-7 06/18/83 - 06/24/83	STS-2 11/12/81 - 11/14/81	STS 51-A 11/07/84 - 11/15/84	STS 61-B 11/26/85 - 12/03/85	STS-47 09/12/92 - 09/20/92
01	STS-6 04/04/83 - 04/09/83	STS-1 04/12/81 - 04/14/81	STS 41-D 08/30/84 - 09/04/84	STS 51-J 10/03/85 - 10/07/85	STS-49 05/07/92 - 05/16/92

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May 6, 1993

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Johnson Space Center, Houston
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EDITORS NOTE: N93-24

SPACELAB D-2 POSTFLIGHT PRESS CONFERENCE TO BE HELD MAY 18

The STS-55 Spacelab D-2 postflight crew press conference will be held Tuesday, May 18, at 2:30 p.m. EDT at the Johnson Space Center, Houston, in building 2, room 135.

The crew members will narrate film highlights of their German research mission to study life sciences and materials processing in microgravity. The briefing will be carried on NASA Select television with two-way audio for questions from NASA Headquarters and other centers. NASA Select programming is carried on SATCOM F2R, transponder 13, located at 72 degrees west longitude.

News media with mission badges will not need further accreditation. Crew members will not be available for interviews until after the postflight press conference.

- end-

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For Release

Ed Campion
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May 6, 1993

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RELEASE: 93-79

COLUMBIA'S RETURN MARKS SIGNIFICANT SPACE SHUTTLE MILESTONES

With the return this morning of the Space Shuttle Columbia from its 14th successful mission, just over 1 full year of flight time in space has been accumulated by the Space Shuttle fleet. In that time, a number of significant statistics have emerged.

The 1-year mark was surpassed at 10:01:42 a.m. EDT on May 5. With the landing at the Dryden Flight Research Facility, Edwards, Calif., at 10:30 a.m. EDT today, the total accumulated Shuttle flight time stands at 365 days, 23 hours and 28 minutes.

The Space Shuttle flight era began with STS-1 and the launch of Columbia on April 12, 1981 with mission Commander John Young and Pilot Robert Crippen. Since then, Space Shuttles have carried to orbit 670 major, fixed and deployable payloads and experiments totalling 822 tons and returned 636 weighing 425 tons.

Representing only 5 percent of all U.S. space launches, Space Shuttles have carried 56 percent of all U.S. payloads to orbit and 44 percent of all U.S. cargo weight to orbit.

Fifty-one satellites have been deployed, 5 of which were recovered and returned on the same flight. Three of the 51 satellites were interplanetary probes to Venus (Magellan), Jupiter (Galileo) and the Sun (Ulysses). Three were orbiting observatories - the Hubble Space Telescope, the Gamma Ray Observatory and the Upper Atmosphere Research Satellite.

- more -

Others were communications satellites and experiment platforms such as the Long Duration Exposure Facility which orbited Earth for nearly 6 years before being retrieved and returned to Earth. Two communications satellites, the PALAPA-B2 and WESTAR-VI, were later retrieved, returned to Earth for refurbishment and relaunched.

Scientific studies aboard the Space Shuttle and in Spacelab modules carried aboard Shuttles have investigated life sciences, materials sciences, combustion science, solar science and physics, space plasma physics, atmospheric studies, biotechnology, Earth observations, astronomy and the study of the behavior of metals, semiconductors, bio-processing and fluids in the microgravity enviroment of space flight. Time accumulated in Spacelab science operations, alone, stands at 96 days and 13 hours.

Including 16 non-U.S. flyers representing 10 different countries, 161 individuals have flown in space at least once on the Shuttle. Astronauts have conducted 16 rendezvous operations, the retrieval and repair of 3 satellites and 20 spacewalks totalling over 223 hours. Six of them were untethered free-flights using the manned maneuvering unit.

- end -

"365 DAYS IN SPACE"
A STATISTICAL STUDY OF SPACE SHUTTLE PRODUCTIVITY
As of STS-55 landing on May 6, 1993

SIGNIFICANT MILESTONES

Missions Launched: 55 (approx. 5 percent of total U.S. launches)
Miles Traveled: Over 130 million statute miles
Orbits Flown: Over 6,200
Mission Success Rate: 98.181 percent (54 of 55 flights successful)

HUMAN ACTIVITY ON SHUTTLE

Shuttle Man-Years in Orbit: 5.7 (65 percent of total U.S. man-years)
(25 percent of total man-years)

Individuals Flown in Space on Shuttle: 161 (55 percent of total humans in space)

* 145 U.S. flyers (80 percent of total Americans in space)
* 16 non-U.S. flyers representing 10 countries
* 89 flyers have made multiple flights

SHUTTLE PAYLOADS LAUNCHED & RETURNED

Payloads to Orbit: 670 (approx. 56 percent of total U.S. payloads to orbit)
(approx. 16 percent of total announced payloads to orbit)
(Note: Includes major attached payloads and experiments, deployables)

Payloads Returned to Earth: 636

Satellites Deployed: 51
Satellites Retrieved and Repaired: 3 (Solar Max, LEASAT-3, INTELSAT-V)
Satellites Retrieved and Returned to Earth: 9 (2 refurbished and relaunched)

SHUTTLE WEIGHT-LIFTING RECORD

Cargo Weight to Orbit: 1.64 million lbs (822 tons) (44 percent total U.S.)
Cargo Weight Deployed: 756,000 lbs (378 tons)
Total Weight (including Orbiters) to Orbit: approx. 13.5 million lbs

- more -

MISCELLANEOUS

Shuttle Rendezvous Operations: 16
Shuttle Spacewalks (EVAs): 20 (16 planned and 4 unplanned; 6 free-flyers)
Total Shuttle EVA Time: 223 hours
Space-walking Shuttle Astronauts: 22 (46 percent of total U.S. spacewalkers)
Women Flown in Space on Shuttle: 19
American Minority Astronauts Flown: 11
Members of Congress Flown: 2

Shuttle Orbiter Flights

Discovery	16
Columbia	14
Atlantis	12
Challenger	10
Endeavour	3

Spacelab Missions: 12 (including 96 days, 13 hrs. of science operations)

Note: These statistics are based on announced information and as such, are somewhat conservative. Some information regarding Department of Defense missions was unavailable for these calculations.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
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For Release

May 7, 1993

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RELEASE: 93-80

FASTEST SUPERCOMPUTER CAN BOOST U.S. AEROSPACE INDUSTRY

NASA's Ames Research Center, Mountain View, Calif., has added a new computer to its Numerical Aerodynamic Simulation (NAS) supercomputer complex that will boost the computing power of the system by more than six times.

Research scientists use the NAS computers by programming a proposed new aircraft design into the supercomputer. The computer then solves equations millions of times to replicate the "real" air flow around the proposed aircraft design.

"These advances in supercomputer aerodynamics are important because aerospace is the largest favorable contributor to the U.S. balance of trade -- $30 billion last year," said Victor L. Peterson, Ames' Deputy Director. "The U.S. share of the world aerospace market has been declining, but machines like the C90 should help reverse this trend."

The NAS is a unique national facility linking approximately 1,400 industry, university, government and NASA users via a high-speed, wide-area network known as AEROnet.

The new Cray Y-MP C90 supercomputer, the world's fastest, is now in full operation after completing its acceptance tests. It routinely will perform more than 6 billion floating points per second (FLOPS), up from 1 billion FLOPS for the current NAS system. FLOPS is a measure of a computing system's speed in doing basic arithmetic operations.

- more -

The C90 is one of the newest "parallel processing" computers, which use many processors to work simultaneously on various parts of a problem. The C90 has processors and a memory capacity of 256 million words. An upgrade to 1 billion words of memory is scheduled for September. Cost of the system is $48 million.

For 20 years, Ames has worked closely with supercomputer makers on advanced hardware and software to reach the hyper-speeds needed for computer simulation of aerodynamics. Ames is NASA's lead center for supercomputer research. Its supercomputer systems and facilities are the most advanced in the aerospace field and among the best in the world.

According to Dr. F. Ron Bailey, Ames' Director of Aerophysics, speeds for NASA's next large computer, to be acquired in 3 or 4 years, might well do around 50 billion FLOPS. Speeds could reach about a trillion FLOPS by around the year 2000.

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For Release May 10, 1993

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RELEASE: 93-81

WORLD'S LARGEST WIND TUNNEL WILL BE WORLD'S QUIETEST

The world's largest wind tunnel soon will be the world's quietest, thanks to a $25 million NASA sound insulation project.

NASA will design and install an acoustic lining in the 40-by-80-foot test section of the National Full-scale Aerodynamics Complex (NFAC) at NASA's Ames Research Center, Mountain View, Calif. The improved wind tunnel ultimately will help U.S. industry design quieter engines for a future high-speed civil transport and for new, advanced helicopters.

"It will provide the United States with a world-class capability that will help us greatly during the next generation of aeronautical research," said Ames Project Manager John Allmen. "After workers install the acoustic lining, echoes will be greatly reduced. Microphones will be able to measure engine and rotor sounds much more accurately with fewer sound waves bouncing off the walls."

Background noise and echoes in the wind tunnel test section cause problems for measuring sound during engine tests. The deeper the acoustic liner, the lower the sound frequency engineers can measure accurately.

Construction workers will install a dense acoustic lining in the NFAC's 40-by-80-foot test section walls, floor and ceiling. The insulation material comes in wedges 42 inches deep and about 4 feet square to cover that entire area. The new lining is similar to the spun Fiberglas commonly used to insulate houses.

-more-

Project design will take the next 2 years. Construction is scheduled to begin in the spring of 1995. During construction, the test section will shut down for more than a year.

Workers also will modify the wind tunnel's motor generators to let engineers send more electric power to the main drive motors. "Normally, we rotate the main drive motors at 180 rpm, but now we will be able to rotate them at half that speed and cut the noise levels by 75 percent, " Allmen said. "This major reduction in background noise will allow us to reach speeds of 100 knots (105 mph) quietly."

Allmen noted that the tunnel's net operational costs will not rise after the project is complete. "The modification costs are about one-twentieth of the cost of building a new facility, which would cost more than $500 million," he said.

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May 11, 1993

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RELEASE: 93-82

NASA AND NATIONAL INDUSTRY RESEARCH GROUP SIGN AGREEMENT

NASA and the National Center for Manufacturing Sciences (NCMS) have signed an agreement which will allow the two organizations to propose joint research projects.

The national center is a non-profit research consortium created by U.S. industries to conduct, sponsor, fund and otherwise promote scientific research, development and demonstrations of technologies or scientific applications which will improve manufacturing processes and materials in the United States and Canada.

NASA Administrator Daniel Goldin said "One of NASA's responsibilities is to help transfer our skills and knowledge to the industrial base of this nation. This agreement will help us carry out that responsibility." Goldin added that NASA has much to learn from the NCMS member industries and looked forward to research projects which would use NASA's aeronautical and space science test facilities in joint projects with industry.

Under terms of the agreement, NASA divisions or centers can propose joint research projects with individual member industries of the NCMS. The industries are equally free to propose joint research projects with elements of NASA. The collaborative activities also can include joint workshops covering any manufacturing process or material or research facility.

- more -

These separate research projects would be subject to separate agreements in two categories: reimbursable and non-reimbursable. The reimbursable activities include those uses of NASA facilities such as wind tunnels or vacuum chambers for research projects which NASA has a minimal collaborative interest. The non-reimbursable activities would include collaborative projects using NASA or NCMS industry facilities or equipment for which both parties have a strong interest.

The overall agreement maintains a NASA program priority for use of facilities which might be covered in separate joint research agreements. The agreement also calls for shared distribution of profits produced by NCMS member industries achieved through collaboration with NASA.

Conversely, the agreement allows NCMS members which shared in collaborative research projects to have reasonable access for reasonable periods of time to NASA patents which resulted from that research.

Because the overall agreement allows for patentable research, the agreement is heavily oriented toward the protection of both NASA and NCMS member industry's intellectual and patent rights.

- end -

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For Release
May 12, 1993

NOTICE TO EDITORS: N93-26

STS-57 PREFLIGHT SCHEDULED; STS-55 POSTFLIGHT RESCHEDULED

The STS-57 Space Shuttle mission preflight briefings will be held May 18 at the Johnson Space Center, Houston, building 2, room 135.

The STS-55 Spacelab D-2 postflight crew press conference, originally announced for May 18, has been rescheduled for May 19 at 11 a.m. EDT.

The STS-57 mission will include the retrieval of the European Retrievable Carrier, the first flight of SPACEHAB (a laboratory for commercial experiments), the Super Fluid Helium On-Orbit Transfer experiment and a spacewalk.

All briefings will be carried on NASA Select television with two-way audio for questions from participating NASA locations. NASA Select programming is carried on SATCOM F2R, transponder 13, located at 72 degrees west longitude.

STS-57 PREFLIGHT BRIEFINGS
May 18, 1993

Time EDT	Briefing	Location
9:30 a.m.	Mission Overview Al Pennington, Lead Flight Director	JSC
10:30	EURECA (European Retrievable Carrier) Alan Dover, EURECA Manager, KSC Dr. Rasaello Carli, EURECA Instrument Engineer	KSC

-more-

12:00	SHOOT (Super Fluid Helium On-Orbit Transfer) Neal Barthelme, Mission Manager Dr. Michael DiPirro, Principal Investigator	GSFC
2:30 p.m.	EVA (Extravehicular Activity or "Spacewalk") Richard Fullerton, EVA/Crew Systems Section	JSC
4:00	STS-57 Crew	JSC

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For Release

May 14, 1993
Noon

RELEASE: 93-84

NASA AMES TO DRIVE RUSSIAN ROBOT VIA SATELLITE

Scientists at NASA's Ames Research Center, Mountain View, Calif., will use a satellite video link, provided by Brown University, next week to try to maneuver a Russian robotic "rover" in a Moscow laboratory. This test is being conducted at the request of McDonnell Douglas Space Systems.

"We will be steering the rover around remotely," said Project Leader Dr. Butler Hine, an Ames electrical engineer. "We will be able to see through the rover's cameras and also through cameras looking at the rover," Hine said.

Hine will use a "telepresence interface" developed at Ames to control the prototype of a rover which Russian scientists hope to land on Mars in 1996. Hine will wear a video headset and use head movements to point the rover's camera. He will use joysticks to steer the rover.

The objective of this test is to verify that this technology could be used in future missions such as Mars 96.

During the tests, NASA scientists will use the same technology they used in February to test the rover when Russian scientists visited Ames.

"During their visit, we drove the rover around our lunar terrain simulation and controlled it from our laboratory," Hine said.

"We call this a 'tele-operator interface' because it is a combination of virtual reality and telepresence," he said. "We can drive the vehicle by looking through the rover's cameras, which is telepresence. We also can drive it using a computer-generated graphic simulation, which is virtual reality," Hine said.

- more -

Hine said the "tele-operator interface" is designed to be a general purpose control mechanism for robotic vehicles. "So far, we have controlled surface rovers, underwater vehicles in the Antarctic and now the Russian rover," Hine said.

Hine will have a model of the Russian test environment as well as a model of the rover at Ames. Depending on weather conditions, the Russians may test the rover outdoors or in a laboratory.

"This is a team effort," Hine said. "There's a large group of people at McDonnell Douglas and a large group of people here at Ames working together. Hine calls this project a good example of technology transfer between the federal government and private industry.

"We've been doing a series of experiments with McDonnell Douglas over the past month to prepare for this test. They are benefiting from the technology transfer.

"We've had experience operating long-haul links to the Antarctic, so we don't expect any major barriers," Hine said. "It is costing us almost nothing," Hine said. "We're re-using the infrastructure developed for other projects."

Scientists from the Russian Academy of Sciences, the Institute for Space Research and the Russian Space Agency also will participate in the test.

Hine is the Project Leader at Ames, and John Garvey is the project leader at McDonnell Douglas.

- end -

Editors Note: Video and photos of the Russian rover are available by calling the NASA Headquarters Broadcast And Imaging Branch at 202/358-1741.

Color	B&W
93-HC-181	93-H-194

NASA News

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For Release
May 14, 1993

RELEASE: 93-85

SOLICITATION ISSUED FOR TECHNOLOGY REINVESTMENT PROPOSALS

The solicitation of proposals for the Technology Reinvestment Project was published today in the Commerce Business Daily and will be published early next week in the Federal Register.

The Technology Reinvestment Project is a $471 million federal interagency effort to develop and deploy dual-use technologies and at the same time give a competitive advantage to American companies. The solicitation seeks proposals in a wide range of technological areas from companies and industry-university partnerships. Proposals are due by July 23, 1993.

The overall goal of the project, which is part of the White House $1.7 billion Defense Reinvestment and Conversion Initiative, is to commercialize technologies developed in federal research and development laboratories.

The project is structured to create new, high technology products, processes, and manufacturing skills that will lead to the creation of high quality jobs in the commercial sector that both enhance American competitiveness and make advanced military systems more affordable.

Funding for the project comes from Defense Department funds. The project also has aspects which will work to develop and enhance engineering curricula at major universities and technical schools to meet the anticipated competitive challenges of this decade.

- more -

NASA is participating in this project with the Department of Defense Advanced Research Projects Agency, the Commerce Department National Institute of Standards and Technology, the Department of Energy and the National Science Foundation. Representatives from each of the participating agencies constitute the review and selection panels for the proposals.

Copies of the solicitation can be obtained by calling the Technology Reinvestment Project's 1-800-DUAL-USE (382-5873) number. Copies of the solicitation are available to the media at the Department of Defense Directorate for Defense Information, Room 2E765, Pentagon, (703/695-0192) and at the NASA Headquarters newsroom, 300 E Street, SW, Washington, D.C. (202/358-1600).

- end -

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For Release

May 17, 1993

RELEASE: 93-86

LEWIS SPACE RESEARCH SPAWNS WATER PURIFICATION SYSTEM

A new material for removing toxic metals from water may benefit hundreds of industries that produce large amounts of contaminated waste water.

Researchers at NASA's Lewis Research Center, Cleveland, have developed an ion exchange material that in laboratory tests can effectively remove contaminants from water such as mercury, lead, cadmium, silver, copper, zinc, nickel, yttrium and chromium.

"The tests also show that the new material is easy to use and inexpensive to produce. It is strong, flexible and chemically very stable in storage," according to Dr. Warren H. Philip, Senior Research Chemist in the Materials Division. He and Ken Street, Head of the Chemical Sampling and Analysis Branch of the Lewis Office of Environmental Programs, invented the material.

The ion exchange membrane originally was developed as a separator in batteries for use in space flight. The separator can be made in many different forms and sizes including thin films, coatings, pellets and fibers for use in larger systems.

These various forms allow the material to be usable in many different applications, including woven fiber filters for home water filters, packed columns of pellets for industrial use and coatings on screens which can be drawn through ponds and lakes needing cleaning.

Drs. Phillip and Street point out that another important feature of the ion exchange material is that adsorbed or collected metals can be easily reclaimed by either a destructive or non-destructive process.

- more -

Through the destructive process, the used ion exchange material is ashed and produces carbon dioxide and water vapor. Oxides of the adsorbed metals remain as ash and can be recycled.

With the non-destructive process, the heavy metals are removed from the ion exchange material and reclaimed by an acid stripping process. The material then is reusable, and the metal concentrate can be recycled.

To extend the effort beyond the laboratory, Lewis officials have signed a space act agreement with Aetna Plating Company, Cleveland, to validate the ion exchange material in an industrial setting.

Under terms of the agreement, Aetna will allow testing of the ion exchange material in their industrial electroplating operation to assess the material's effectiveness as an agent for removing heavy metals.

The Lewis Technology Utilization Office is responsible for project management. Cooperating and assisting on the project are the Cleveland Advanced Manufacturing Program's Advanced Manufacturing Center and Cleveland State University.

This ion exchange material is an example of technology transfer – technology developed for one purpose that can be applied to uses different from the original intent.

Through its Technology Utilization Program, NASA seeks to encourage greater use of the knowledge bank by providing a link between the NASA research community and those that might develop the product of that research into a commercial technology or product.

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NASA News

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May 17, 1993

RELEASE: 93-87

INTERNATIONAL MARS EXPLORATION GROUP FORMED

NASA, the European Space Agency, the Russian Space Research Institute (IKI), the Italian Space Agency, the German Space Agency and the French Centre National d'Etudes Spatiales have decided to form an International Mars Exploration Working Group to produce an international strategy for the exploration of Mars after the year 2000.

This decision was made during a meeting in Wiesbaden, Germany, on May 10, 1993.

This marks the first time that the agencies have agreed to develop a multilateral strategy on the exploration of Mars. The working group also will examine the possibilities for an International Mars Network mission. In addition, it will provide a forum for the coordination of future Mars exploration missions.

All interested space agencies that wish to participate will be invited to join the working group. The first meeting is scheduled in Graz, Austria, in October 1993.

During this meeting in Wiesbaden, the space agency representatives, together with scientists from around the world, also unanimously expressed their support for the Russian Mars 96 mission, an extension beyond 1996 for the U.S. Mars Observer mission and a new start for the Mars Environmental Survey Pathfinder mission in 1994.

-end-

News

National Aeronautics and
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For Release May 17, 1993

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RELEASE: 93-88

NASA JOINS FORCES WITH INDUSTRY IN AIDS RESEARCH

NASA and American Bio-Technologies Inc., of Cambridge, Mass., have teamed together in an attempt to contribute to a better understanding of a world public health problem -- Acquired Immune Deficiency Syndrome (AIDS). Under an agreement signed April 26, each organization will bring its own unique capabilities to a comprehensive research effort.

"This endeavor represents a massive and unprecedented approach to structure-oriented AIDS research," said Simon McKenzie, American Bio-Technologies President.

The goal is to use advanced x-ray crystallography technology and expertise developed by NASA's Marshall Space Flight Center, Huntsville, Ala., to advance fundamental knowledge of Human Immunodeficiency Virus (HIV) and AIDS, to develop new and promising therapeutic approaches for HIV and AIDS and to develop superior biological materials for vaccine development and HIV detection.

The structural biology research group at the Marshall center will bring new emerging technology in high-brilliance x-ray generators, access to the microgravity environment aboard the Space Shuttle and novel crystallization approaches to bear on the research effort.

American Bio-Technologies, the major world supplier of recombinant (synthetic) HIV proteins, will provide researchers at Marshall with all proteins of HIV-1 and related retroviruses.

"Normally, a research group is considered very fortunate to have access to a single protein from HIV-1 for crystallographic purposes," explained Dr. Daniel Carter, Chief of the Biophysics Branch of Marshall's Space Science Laboratory. "We will have access to quantities of all of them."

- more -

"We will use our unique capabilities to grow crystals of the proteins and then use our analytical and computer-based technologies to attempt to determine the accurate three-dimensional structures of the biological molecules. Our group previously determined the first structure of a human antibody which recognizes the AIDS virus, published in the Proceedings of the National Academy of Sciences last summer," explained Carter.

Knowledge of the structures of molecules provides critical insights into molecular function. Such insights can speed the design of vaccines, pharmaceuticals or inhibitory agents to prevent or cure diseases, according to the National Institutes of Health. The organization believes that structural biology is the linchpin in U.S. biotechnology research.

"Critical to the success of such endeavors is the production of relatively large, high-quality single crystals of the proteins of interest," explained Carter. "Consequently, large and expensive quantities of recombinant protein are required for each targeted structure. American Bio-Technologies is uniquely positioned to support this strategy."

American Bio-Technologies and NASA research groups are pursuing what is one of the greatest research problems of our time with a true sense of urgency and great purpose, according to Carter.

"Today, only two structures of the approximately 20 proteins of HIV-1 have been determined and none from the related viruses HIV-2, HTLV-1, HTLV-II and SIV, have been determined," McKenzie added.

If successful, determination of the atomic structures of HIV and HIV-related retroviruses could provide key insights into the critical function of many of the virus components essential to the development of new vaccines, therapies and diagnostics.

Both NASA and American Bio-Technologies intend to publish the results of their efforts under this agreement.

- end -

News

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For Release

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May 18, 1993

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RELEASE: 93-89

MAGELLAN TO TEST AEROBRAKING MANEUVER IN VENUS ATMOSPHERE

NASA's Magellan spacecraft will dip into the atmosphere of Venus beginning May 25 in a first-of-its-kind "aerobraking" maneuver, lowering the spacecraft's orbit to start a new experiment.

The aerobraking technique will use the drag created by Venus' atmosphere to slow the spacecraft and circularize Magellan's orbit. Currently Magellan is looping around Venus in a highly elliptical orbit.

"This aerobraking technique has never been used before on a NASA planetary mission," said Douglas Griffith, Magellan project manager at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

"Magellan has been highly successful in completing all of its primary mission goals," said Alphonso V. Diaz, Deputy Associate Administrator for NASA's Office of Space Science. "The new orbit will enhance the scientific return from what is already one of NASA's most successful space science missions."

According to Griffith, aerobraking is the only way to make such a large change in Magellan's orbit because the spacecraft does not have enough thruster fuel onboard for the change. "Although aerobraking creates some risk of losing the spacecraft, the scientific benefits make the risk worthwhile," he said.

The benefit of changing the orbit is to make possible better measurements of Venus's gravity field, particularly at latitudes near the planet's poles, said Dr. R. Stephen Saunders of JPL, the Magellan Project Scientist.

- more -

For the past 8 months, Magellan has been collecting data on Venus' gravity. However, measurements from the current elliptical orbit are blurred at high latitudes by the height of the spacecraft above the surface -- about 1,300 miles (2,100 kilometers) near the north pole and 1,700 miles (2,800 kilometers) near the south pole.

Scientists also hope to study Venus's atmosphere using data collected during the aerobraking experiment itself. And another objective is to gain the engineering experience that may allow future missions to use aerobraking to enter planetary orbit or to change orbit without using large thrusters.

Launched in May 1989, Magellan will complete its fourth 243-day orbital cycle at Venus on May 25. During each of the 8-month cycles, Magellan orbits from north to south while the planet turns once underneath the spacecraft.

During earlier cycles, Magellan used its radar to map Venus's surface with a resolution as fine as 250 feet (75 meters). Data was obtained on the elevation, slope, radar reflectivity and radar emissivity over 98 percent of the planet.

In the upcoming maneuver, flight controllers hope to lower the spacecraft from a low point near 100 miles (170 kilometers) and high point of 5,300 miles (8,500 kilometers). The target orbit is 125 by 375 miles (200 by 600 kilometers). This would alter orbit time from 3-1/4 hours to 90 minutes.

The aerobraking experiment will start at 1:30 p.m. EDT May 25, when the spacecraft makes the first maneuver. By controlling the orbit altitude, the drag and heat generated on the spacecraft will be kept within tolerable limits.

Completing the change will take about 80 days. The short period of drag on each orbit, a few minutes at the start to about 20 minutes near the end, will lower the orbital high point by about 6 miles (10 kilometers) on every orbit.

Measuring Venus's gravity field permits scientists to measure the pattern of heavier and lighter regions under the planet's surface. It is the only technique currently possible to look inside Venus and provides information like that gained using seismometers to probe inside a planet. Similar measurements on Earth helped reveal plate tectonics, Earth's fundamental geologic process.

"Without better measurements from a lower orbit, it would remain very hard to understand Venus's internal geology and why it is so different from Earth," said Saunders.

JPL manages the Magellan mission for NASA's Office of Space Science, Headquarters, Washington, D.C.

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For Release

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May 19, 1993

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RELEASE: 93-90

INDUSTRY TESTS NASA COMPUTER PROGRAMS FOR EFFICIENT DESIGNING

NASA and the nation's large aerospace companies are working together to see how NASA computer programs can help industry design and produce aircraft more efficiently.

Member companies of the Multidisciplinary Analysis and Design Industrial Consortium (MADIC) are working with NASA to complete a 1-year evaluation of NASA computer simulation programs to find out how well they work on real aircraft design problems. The Center for Research on Parallel Computation at Rice University, Houston, is coordinating research activities and technical workshops under the project and is a major participant.

The ultimate goal is to integrate all the factors involved in aircraft design and production. Aeronautical engineers traditionally decide on the overall shape of an aircraft first, then separately design the plane's other systems, such as propulsion, flight controls and cockpit displays. Changes to any of the systems during the design process, however, often can have an impact on the other components.

"With these design tools, industry will be able to design aircraft systems simultaneously," said Lee Holcomb, NASA's Director for High Performance Computing and Communications. "This project is a significant step in organizing the institutions who have technologies that can make this multidisciplinary design concept feasible."

- more -

The project, which started in April, will evaluate 10-15 NASA simulation programs, called "solvers", that approximate the physical phenomena involved in aircraft design, such as the lifting power of wings and the weight of components. The study will develop criteria to assess these programs and will come up with a plan to incorporate existing NASA solvers into multidisciplinary design methods.

Testing NASA Software on Real Problems

Two of the solvers will be selected for evaluation by a group of industry researchers. A key part of the project will develop the requirements for using these programs on parallel processing computers, which use many processors to work simultaneously on a problem. The processors are simpler than those in traditional supercomputers, but give a faster result because there are many more of them.

The industry researchers will evaluate the two programs on real design problems to find out how well they agree in selected areas with known solutions. This is vital to integrating design and production factors because, as inputs constantly change, their effect on the ultimate design must be measured accurately.

"Multidisciplinary analysis and design will represent an increasingly important application for parallel computation and if it can be done efficiently, it eventually could revolutionize the practice of engineering design," said Ken Kennedy, Director of the Center for Research on Parallel Computation at Rice.

Project researchers from NASA, Rice University, Syracuse University, Argonne National Laboratory and the MADIC consortium are taking part in the effort.

MADIC is a group of U.S. firms interested in developing pre-competitive software for multidisciplinary design systems. Members include General Dynamics, General Electric, Grumman, Lockheed, McDonnell Douglas, Rockwell-North American Aircraft, Vought and United Technologies.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600

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Headquarters, Washington, D.C.
(Phone: 202/358-1757)

Marilyn Edwards
Lewis Research Center, Cleveland
(Phone: 216/433-2899)

For Release

May 19, 1993

RELEASE: 93-91

LEWIS, CASE , BATTELLE TO COMMERCIALIZE NASA INVENTIONS

NASA's Lewis Research Center, Case Western Reserve University and the Battelle Memorial Institute, all of Cleveland, today announced the kick-off of a new initiative to commercialize NASA inventions by using top graduate students at Case Western to come up with new product ideas and strategies.

Lewis Research Center Director Larry Ross said that "ensuring that NASA innovations can be applied in the marketplace is a high priority at Lewis. We believe this important new program will put some of the best young minds in the area to work on finding new product ideas for the innovations of some of our top scientists and engineers."

The program is known as the Strategic Technology Evaluation Program (STEP), a joint activity of Lewis, the Great Lakes Industrial Technology Center (managed by the Battelle Memorial Institute), the Weatherhead School of Management, the Center for the Management of Science and Technology and Enterprise Development Inc., all units of Case Western Reserve University.

"We are excited about this program," said Scott Cowen, Dean of the Weatherhead School of Management. "We believe the Case Western Reserve graduate students will bring a new perspective to commercializing these promising federal government innovations."

The new project is a precedent-establishing program in which a dozen top graduate students at Case Western Reserve, chosen from diverse fields including engineering, business, law and architecture, work as a team to develop commercialization strategies for selected inventions developed at Lewis over the past several years.

- more -

During the next 8 weeks, the students will examine more than 90 NASA patents and invention disclosures. The inventions the students will be examining primarily will be in the materials, electrical and electronic and mechanical areas.

"This kind of government-university-industry cooperation has been critical to American economic competitiveness in the recent past," Douglas Olesen, President and CEO of the Battelle Memorial Institute, said. "This program is a clear example of the great potential of such cooperative activity. I am particularly pleased by the high level of hands-on industrial involvement in the program."

The students will be guided by an industrial advisory group comprised of leading industrialists, venture capitalists, patent attorneys and commercialization experts from throughout Ohio.

The students have been chosen on the basis of both their academic work and work-related experience and will be supervised in their research by the Weatherhead School of Management faculty. Students will be paid for their work and will be given the option of receiving academic credit as well.

The following list comprises the preliminary membership of the student's Industrial Advisory Group:

Dr. Jere Brophy, Vice President for Technology, Brush Wellman Corp.; Robert Erdman, New Business Development Director for Keithley Instruments, Inc.; William Grimberg, Cleveland Tomorrow Technology Leadership Council Director; Dr. Cinda Herndon-King, Vice President of Technology and Education, Edison BioTechnology Center; John Laskowski, Commercialization Manager for Cleveland Advanced Manufacturing Program; Dr. Thomas Purcell, Vice President and Corporate Director of Research, Ferro Corp.; Charles Rivenburgh, Director of Technology Transfer, Edison Polymer Innovation Corp.; Raymond Rund, Partner, Brantley Venture Partners; Bill Sanford, President and CEO, STERIS Corp.; and Dr. Odo Struger, Vice President of Technology Development, Allen-Bradley - all of Cleveland

- end -

NASA News

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ISY

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For Release May 20, 1993

Jim Elliott
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N93-27

HUBBLE BRIEFING: WHAT HAPPENS WHEN GALAXIES COLLIDE?

A new Hubble image revealing details of the heart of a head-on collision between two galaxies will be the subject of a media briefing at 1 p.m. EDT, Tuesday, May 25, 1993, at NASA Headquarters, 300 E Street S.W., Washington, D.C. This new discovery is the best evidence to date for solving more than half a century of theory about how elliptical galaxies may form.

Presenting the new findings will be Dr. Brad Whitmore, astronomer, Space Telescope Science Institute, Baltimore, Md. Commenting on the significance of the discoveries will be Dr. Francois Schweizer, astronomer, the Carnegie Institution of Washington, Washington, D.C.

Host Dr. Stephen Maran, NASA's Goddard Space Flight Center, Greenbelt, Md., will be joined by Dr. Bruce Margon, Professor of Astronomy and Chairman of the Department of Astronomy, University of Washington, Seattle, and Dr. Daniel Weedman, Professor of Astronomy, Pennsylvania State University, University Park.

The new Hubble image and animation of colliding galaxies will be available to the media through NASA's Broadcast and Imaging Branch, 202/358-1738 on Tuesday, May 25, 1993.

The briefing will be held in the Audio/Video Center on the concourse level of NASA Headquarters. From the hallway, go to room CB33, then to room C25. Signs will be posted.

This event will be carried live on NASA Select television, Satcom F-2R, Transponder 13, located at 72 degrees West Longitude, frequency 3960.0 MHz, audio 6.8 MHz. Questions will be taken from participating NASA centers.

- end -

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ISY

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May 20, 1993
For Release

RELEASE: 93-92

NASA TO FEATURE VIDEOWALL AT PARIS AIR SHOW

A 50-monitor videowall will highlight the NASA exhibit at the 40th Paris Air Show, Le Bourget, France, June 10-20. The video presentation features interviews with Carl Sagan, James Michener, Roald Sagdeev, Norman Augustine and Kathy Sullivan, discussing space station, space technology, space science, space exploration and aeronautics.

This year's exhibit theme, "A New Age of Exploration-- Expanding the Frontiers of Air and Space for the Benefit of All," incorporates a large panoramic mural at the exhibit's entrance acknowledging the many contributions of NASA's international partners in human and robotic spaceflight and the importance of continued international cooperation to meet the challenges of the 1990's and beyond.

In addition to the videowall, a new 10-foot model of a High Speed Civil Transport aircraft, a Pratt and Whitney mixer-ejector nozzle, and a high altitude Perseus model will be displayed. The display also will highlight NASA's work to develop technology for a new generation supersonic airliner focusing on exhaust emissions, airport noise and sonic boom research.

NOTE TO EDITORS: NASA will conduct the following press briefings in the USA Pavilion at LeBourget:

June 11 Aeronautics Overview
Dr. Wesley Harris, Associate Administrator, Office of Aeronautics

June 14 Hubble Space Telescope Servicing Mission Overview,.
Astronaut Pierre Thuot

June 15 High Speed Research Program Overview, Louis Williams, Director, High Speed Research Division

U.S./Russian Cooperation Overview, Guy Gardner, Deputy Associate Administrator (Russian Programs), Office of Space Flight

-end-

News

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For Release
May 20, 1993

RELEASE: 93-93

METABOLIC SPACEWALK STUDIES SUBJECT OF AMES RESEARCH

Scientists at NASA's Ames Research Center, Mountain View, Calif., are measuring how the human body reacts to exercise here on Earth that is similar to astronauts working in the microgravity environment of spaceflight.

Astronauts have used spacewalks to rescue and repair satellites and perform other important tasks outside the Space Shuttle. Spacewalks are not now a routine method of exploration. But assembly, maintenance and repair of the Space Station will require spacewalks to become an everyday part of working in space, said Rebecca Williamson, one of the Ames co-investigators.

"A logical step is to try to improve the productivity of the space walking astronaut to increase the amount of labor performed per spacewalk hour," she said. Current technology requires the astronaut to control the temperature of the liquid cooling garment manually. The garment is a tight-fitting system inside the spacesuit to remove heat generated when the astronaut works.

"Experience with the current extravehicular activity system shows that heat balance inside the suit is poorly controlled," Williamson said. "Some areas of the body are too warm, while others are uncomfortably cold."

The Ames researchers hope an advanced heat balance control system could determine an astronaut's metabolic rate by analyzing the air exhaled by the astronaut. The system then would automatically change its cooling function. "This would lead to greater comfort for the astronaut, resulting in less fatigue and greater productivity," she added.

- more -

"The exercise involves using the arms rather than legs to crank a device similar to a bicycle while lying on their back," Williamson said. Known as an ergometer, the device measures the amount of work done by the muscles. The ergometer can be locked in place or allowed to "float," producing a feeling of weightlessness. Restraints, simulating footholds in the Space Shuttle's payload bay, hold the volunteer's feet in place.

The ergometer is inside a controlled atmosphere chamber. This allows scientists to measure changes in air temperature and humidity inside the chamber as the volunteer exercises. A nose clip and mouth piece permit measurement of the amount of carbon dioxide and oxygen exhaled. Heart rate and skin temperature are monitored and recorded as well.

The 10 male volunteers, ages 20 to 45, exercise according to five different profiles. These include low, moderate and high level, constant workloads.

Another exercise profile is called maximum output, in which the subject cranks as hard as possible for 1 minute after a five-minute warm-up period. The final profile involves exercise at workloads that change every 5 minutes. Each volunteer will perform each profile three times over a period of several weeks. The length of each profile varies from about 14 minutes to 45 minutes.

Previous research has shown that exercise on the ergometer results in physiological and thermal responses similar to those achieved during extravehicular activities (spacewalks) performed by astronauts in space.

Dr. Bruce Webbon, Chief of the ExtraVehicular Systems Branch at the Ames Advanced Life Support Division, is the principal investigator for this system. Williamson and Peter Sharer, both of Sterling Federal Systems Inc., are co-investigators. The team expects to complete the current phase of their research by September 1993.

- end -

EDITORS NOTE: Photographs to illustrate this story are available to media representatives by calling NASA Headquarters (202/358-1738) or Ames Research Center (415/604-9000). A video also is available from the Ames center.

Color: 90-HC-68 and -69

NASA News

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For Release
May 21, 1993

EDITORS NOTE: N93-28

NASA SETS JUNE 3 AS DATE FOR THE STS-57 SHUTTLE MISSION

NASA managers today set June 3, 1993 as the target date for the next flight of the Shuttle system. The STS-57 mission will see Space Shuttle Endeavour and her six person crew conduct a mission highlighted by the retrieval of the European observation satellite EURECA and the first flight of a commercial spacelab facility known as Spacehab.

The June 3 target date is based on completion of work in progress to understand the cause of a noise/vibration event experienced during launch pad processing.

The launch window on June 3 opens at 6:17 p.m. EDT and extends for 1 hour and 11 minutes. The limited launch window time is based on EURECA retrieval requirements. The mission duration is planned for 7 days. However, it may be extended by 1 day immediately after launch if projections calculated at that time for electircal power consumption permit an extra day in space. The extra day will give two members of Endeavour's crew the opportunity to perform an extravehicular activity (EVA) or spacewalk.

Leading the STS-57 crew will be Mission Commander Ronald Grabe. Pilot for the mission is Brian Duffy. Heading up the science team will be Payload Commander David Low who also is designated as Mission Specialist-1. The three other mission specialists for this flight are Nancy Sherlock (MS-2), Jeff Wisoff (MS-3) and Janice Voss (MS-4).

This will be the fourth flight of Space Shuttle Endeavour and the 56th flight of the Space Shuttle system.

- end -

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Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/358-0883)

For Release
May 24, 1993

Franklin O'Donnell
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

NOTICE TO EDITORS: N93-29

MAGELLAN PRESS BRIEFING SCHEDULED

Initial progress of the Magellan spacecraft's aerobraking maneuver and recent gravity findings at Venus will be the topic of a press briefing Wednesday, May 26, at 1 p.m. EDT.

The press briefing will originate from the Audio/Video Center at NASA Headquarters, 300 E. Street, S.W., Washington, D.C., and will be broadcast over NASA Select television.

On May 25 Magellan will complete its fourth 8-month orbital cycle at Venus and will dip into the planet's atmosphere in a new aerobraking experiment to lower Magellan's orbit. At that point, Magellan will have successfully completed all of its mission objectives by collecting radar maps of 98 percent of Venus' surface as well as data on the planet's gravity field.

The press briefing will include a status update on the aerobraking experiment and a release of photos and video from Magellan's gravity studies during its fourth orbital cycle.

Speakers will include Dr. Wesley Huntress, Associate Administrator for NASA's Office of Space Science; Douglas Griffith, Magellan Project Manager at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., ; Dr. William Sjogren, Principal Investigator of Magellan's gravity experiment; Dr. Ellen Stofan, Magellan Deputy Project Scientist; and Dr. R. Stephen Saunders, Magellan Project Scientist.

NASA Select television is carried on Satcom F2R, transponder 13, located at 72 degrees west longitude. Two-way question-and-answer capability will be available at JPL and other NASA centers.

- end -

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For Release

May 25, 1993
Embargoed until Noon

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RELEASE: 93-94

SCIENTISTS LOCATE NEW RADIATION BELT AROUND EARTH

The location of a radiation belt of cosmic rays -- particles from beyond the solar system -- has been pinpointed several hundred miles above the Earth, according to scientists from the California Institute of Technology, Pasadena, and NASA's Goddard Space Flight Center, Greenbelt, Md.

A NASA satellite called Solar, Anomalous and Magnetospheric Particle Explorer (SAMPEX), was orbiting 375 miles (600 kilometers) above the Earth when it measured the belt.

The belt is most intense above a 5,000-mile (8,050- kilometer) strip of Atlantic Ocean between the southern tips of South America and Africa, Caltech and NASA scientists said at the annual meeting of the American Geophysical Union in Baltimore, Md., on Tuesday, May 25.

The belt is composed of particles known as anomalous cosmic rays, which are the result of the sun's interaction with tenuous gas that exists between the stars in the Milky Way galaxy.

"We were pretty sure the belt was there, and now we've pinned it down along with its location, which we didn't know before," said Goddard's Dr. Tycho von Rosenvinge, a member of the SAMPEX team.

- more -

The first clear evidence for such a radiation belt was discovered by a team of Russian and U.S. scientists in 1991 using information from a series of Russian COSMOS spacecraft.

They were unable, however, to determine directly the location of the belt, which is composed of different high-energy particles than another region of radiation, the Van Allen radiation belts discovered by James A. Van Allen in 1958 using data from NASA's Explorer 1 satellite.

The belt in which the anomalous cosmic rays collect is embedded within the inner of the two Van Allen belts. The geometry of these belts is determined by the Earth's magnetic field lines, which connect the North and South magnetic poles.

"The cosmic rays become trapped in this field, where they bounce back and forth between the poles of Earth's magnetic field," said Caltech's Dr. Richard Mewaldt, a member of the SAMPEX team along with Caltech colleagues Drs. Jay Cummings, Alan Cummings, Richard Selesnick and Edward Stone.

The rays are the most intense in the 5,000-mile (8,050-kilometer) strip between South America and Africa, Mewaldt said, because the Earth's magnetic field is not centered perfectly, and this is where it allows the trapped particles to get closest to the planet's surface.

SAMPEX scientists said trapped cosmic rays can be stored in the belt for weeks or more, so the intensity can build up over time as more arrive. More of the cosmic rays collect in the belt during periods of minimum solar activity, which follows an 11- year cycle.

The trapped radiation has doubled between August and November 1992, according to SAMPEX measurements, and now is about 100 times the intensity of the anomalous cosmic rays in interplanetary space.

"This long-term storage will give the SAMPEX team a unique opportunity to study the properties of interstellar matter right in Earth's back yard," Mewaldt said.

SAMPEX was launched in July 1992 on a Scout rocket from Vandenberg Air Force Base, Calif. The satellite is managed by Goddard for the Office of Space Science at NASA Headquarters in Washington, D.C.

- end -

NOTE TO EDITORS: A color illustration is available to media from NASA's Broadcast and Imaging Branch, 202/358-1741.

Color: 93-HC-191 B&W: 93-H-207

NASA News

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For Release

May 24, 1993

Don Nolan
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RELEASE: 93-95

NASA SYSTEM RESEARCH AIRCRAFT MAKES FIRST TEST FLIGHT

A NASA F/A-18, specially modified to test the newest and most advanced system technologies, made its first research flight on May 21 at NASAUs Ames-Dryden Flight Research Facility, Edwards, Calif. The Systems Research Aircraft (SRA) is evaluating technologies that will benefit both civilian and military aircraft.

"The SRA systems testbed aircraft is a faster, better and cheaper approach that lowers systems development cost and cuts the time needed to develop new technologies," said Denis Bessette, Project Manager at Dryden. "This project will help ensure that new aerospace concepts are transferred to U.S. industry to accelerate transition of those advanced technologies."

The plane's first mission involved tests of an electric actuator that has two small computers to monitor the position and control of one of the aircraft's ailerons. An actuator takes signals from the aircraft's flight control computer and translates them into mechanical actions that move control surfaces such as flaps, ailerons and rudders. The "smart" actuator being tested needs less wiring and should have better performance and reliability than the mechanical actuators now in general use.

The second program scheduled for the aircraft will investigate the use of optical systems on future aircraft. Fiber optic cable is lighter, carries more signals and is resistant to interference from strong radio signals and lightning.

- more -

NASA and industry are working on fiber optic sensors to measure the position of aircraft control surfaces, pilot input to the controls, engine temperatures and other aircraft and engine functions. The measurements from these optical sensors will be compared to the standard aircraft sensors to obtain information on how well the optical systems perform.

A third program will develop a new way to measure an aircraft's speed, altitude and other air data parameters. The method to be tested has no moving parts which will increase accuracy and reliability. Unlike traditional air data sensors which protrude into the airstream and produce drag, the new system uses several flush ports arranged around the tip of the plane's nose.

The advanced actuator program is a joint effort by Ames-Dryden, the U.S. Air Force and the U.S. Navy. The fiber optic research program is a joint program by Ames-Dryden and the Lewis and Langley Research Centers. The air data system studies are a NASA-industry cooperative program with Honeywell and McDonnell Douglas Corp.

- end -

NOTE TO EDITORS: Video and still photos of the System Research Aircraft's first flight are available from the Ames-Dryden media relations office, 805/258-3448.

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For Release

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May 25, 1993

RELEASE: 93-96

HUBBLE SERVICING MISSION STUDY COMPLETED

A task force established by NASA Administrator Daniel S. Goldin to review plans for the Hubble Space Telescope servicing mission concluded that, "the mission is achievable." This conclusion was driven by the fact that the spacecraft and most of its subsystems were designed for on-orbit maintenance.

The Task Force on the Hubble Space Telescope Servicing Mission, chartered in late January, reviewed all aspects of the first servicing mission which is currently scheduled for December 1993. Dr. Joseph F. Shea was Chairman of the task force.

"We were asked to arrive at a judgement as to the likelihood of success of the repair and servicing mission," said Shea. "In our opinion, we think the mission is achievable."

The task force pointed out, however, that the mission is complex and will require more EVA (spacewalk) time than any mission to date. Given this complexity, the task force recommended that a second HST servicing mission be planned 6 to 12 months after the STS-61 flight to handle tasks that might not be completed during the first mission or respond to failures that occur in the intervening months.

Shea said planning and management changes, which have taken place over the past few months, will improve the likelihood of success. "We support the appointment of a Mission Director, and believe that such a position, with authority and resources, is necessary if the mission is to be carried out with confidence," Shea said.

-more-

The task force report also concluded that a full end-to-end simulation of the EVA in the Neutral Buoyancy Simulator at the Marshall Space Flight Center, Huntsville, Ala., which is currently in the planning stage, is "essential to a successful mission."

"There are some areas, like schedule, where we still have some concerns," Shea said. "We think the timelines for the EVAs are very tight and some of the hardware is not fully assembled. But we were very pleased to see that NASA extended the mission duration and the number of EVAs for the flight."

-end-

NOTE TO EDITORS: Copies of the report are available from the NASA Headquarters newsroom by calling 202/358-1600.

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May 25, 1993
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RELEASE: 93-97

HUBBLE LOOKS AT THE HEART OF A GALAXY COLLISION

NASA's Hubble Space Telescope has looked into the heart of a galaxy created by the collision of two galaxies and peering deeply into its nucleus, discovered a remarkable pinwheel-shaped disk of gas surrounded by clusters of young stars born as a result of the merger.

The star clusters apparently were born as a result of the collision of two disk-shaped galaxies. The galaxy merger, which occurred about 1 billion years ago, triggered an infall of the gas which fueled the birth of new stars around the center of the galaxy.

"This may unlock the key for understanding how all globular clusters formed in ellipticals," said Dr. Brad Whitmore of the Space Telescope Science Institute (STScI), Baltimore, Md. "The Hubble observation also shows how tiny disk-like structures might have formed in many other galaxies."

This discovery provides some of the best evidence to date for explaining the origin of giant elliptical galaxies. For more than a half century, astronomers have theorized about how such galaxies formed. Some theories propose that ellipticals formed from collisions between disk galaxies -- flattened stellar systems resembling the Milky Way galaxy.

These results are being presented in a press conference today at NASA Headquarters, Washington, D.C., by Whitmore and Dr. Francois Schweizer of the Carnegie Institution of Washington. Co-investigators are Claus Leitherer, Kirk Borne and Carmelle Robert of STScI.

- more -

Pinwheel of Stars and Gas

The striking Hubble image shows a spiral pattern at the galaxy's core, surrounded by bright star clusters. "I knew I had a major result within 10 seconds of looking at the Hubble picture," said Whitmore.

The pinwheel shaped disk has an uncanny resemblance to a face-on spiral galaxy, yet it is only 10 thousand light-years across -- about 1/20 the size of the total galaxy. The gas and stars in the disk swirl around the nucleus, making a spiral pattern like cream poured in a cup of coffee. The mini-spiral contains enough gas to make 8 billion stars like the sun. Though several of the clusters were first spotted from ground- based telescopes, their true nature was uncertain until the Hubble observations.

Hubble's resolution is so good that the astronomers can measure the diameters (0.04 arc seconds, the apparent size of a dime at a distance of 80 miles) of the bright star clusters seen in the same image as the spiral disk. They turn out to be about 60 light years across, the same size as globular clusters that orbit the Milky Way galaxy.

The globular clusters found in NGC 7252 are considered the progenitors of similar clusters that orbit the Milky Way galaxy. Since globular clusters normally contain ancient red giant stars, they provide a fossil record of the formation and evolution of galaxies. Globular clusters contain about 1 million stars each, arranged in a tight, spherical swarm and generally are found to be about 15 billion years old.

However, the "ultra-luminous clusters" found in NGC 7252 contain hot bluish stars. Because these blue stars are short-lived, the clusters in NGC 7252 are estimated to be mostly between 50 and 500 million years old.

The blue stars make the globular clusters up to several hundred times brighter than the clusters that orbit the Milky Way galaxy. If the Milky Way's globular clusters were as bright, they could be seen with the naked-eye and would be brighter than the stars in the Big Dipper.

In the 1920's, American astronomer Edwin Hubble classified galaxies according to their spiral or elliptical shape. A key difference is that stars are concentrated in a disk in spirals, but are distributed in a diffuse, roughly spherical distribution in ellipticals.

Since Edwin Hubble's time, astronomers have sought an explanation for why there are two different types of galaxies. During the past decade, the hypothesis that spiral galaxies can collide and merge to form elliptical galaxies has become increasingly popular.

- more -

Located 300 million light-years away in the constellation Aquarius, NGC 7252 has been considered the prototypical example of a merger between two disk-shaped galaxies. The galaxy has a pair of long tails that are unambiguous evidence of the effects of gravitational tidal forces from a galaxy merger.

The galaxy NGC 7252 is nicknamed the "Atoms-for-Peace" galaxy because its stars form a bizarre loop-like structure that resembles a schematic diagram of an electron orbiting and an atomic nucleus. (In December 1953. U.S. President Dwight D. Eisenhower made his "Atoms for Peace" speech to foster peaceful applications of nuclear energy.

If globular clusters can be born during galaxy collisions, it reinforces the theory that disk galaxies merge to make giant elliptical galaxies. One argument against this theory is that elliptical galaxies have more globular clusters than expected if disk galaxies were simply combined, since disk galaxies have relatively few clusters.

Hubble Picture Helps to Solve Mystery

The new Hubble Space Telescope observation solves this dilemma by showing that when disk galaxies collide they can form new globular clusters. Rather than being a problem for the merger scenario, an increase in the number of globular clusters is a natural consequence of galaxy mergers.

The existence of a "mini-disk" also fits with the merger scenario since similar disk-like features appear to exist in many elliptical galaxies. Another clear indication that the material originated from the collision of two galaxies is that the mini-spiral is rotating in a direction opposite to the rest of the galaxy.

This discovery is the latest in a series of disk-like structures that Hubble has uncovered at the cores of galaxies. Previously, HST found a giant disk of cool dust and gas orbiting a suspected black hole in the active galaxy NGC 4261 and discovered an edge-on "donut" of dust in the spiral galaxy M51.

The astronomers predict that in a few billion years the gas in NGC 7252 will be exhausted. The galaxy will look like a normal elliptical galaxy with a small inner disk.

- end -

NOTE TO EDITORS: Color and black and white images are available to media from NASA's Broadcast and Imaging Branch, 358-1741. The photo numbers are:

B&W: 93-H-205, -206 Color: 93-HC-190

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For Release

May 26, 1993

RELEASE: 93-98

MAGELLAN AEROBRAKING, GRAVITY STUDIES UNDERWAY

Having successfully completed its original mission of radar-mapping the planet Venus, NASA's Magellan spacecraft is embarking on a new experiment that will give scientists glimpses into the planet's interior and a better understanding of its atmosphere.

On May 25, the spacecraft completed its fourth 8-month cycle of orbiting Venus, during which it collected data on the planet's gravity field, particularly close to the equator.

On that same day, Magellan executed the first in a series of aerobraking maneuvers to be conducted over the next 70 days in which Magellan dips into Venus' atmosphere, taking advantage of drag on the spacecraft to lower its orbit. The maneuvers are designed to place Magellan in a circular orbit, allowing it to get better gravity data at the planet's north and south poles.

"This experiment is a scientific bonus for what is already a highly successful mission," said Dr. R. Stephen Saunders, Magellan Project Scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

According to Saunders, the gravity data that Magellan is collecting allow scientists to "see" into the interior of the planet because they can gauge the density of the material underlying various parts of the planet.

In recent weeks, for example, Magellan passed over a region dominated by three volcanoes -- Hathor, Innini and Ushas. "They occupy a broad swelling of the Venusian crust believed to result from upwelling of hot material from the deep interior, a phenomenon known on Earth as a 'hot spot,'" Saunders added.

- more -

In other ways, Venus seems to be distinctly different from Earth. While Earth's surface geology is largely created by tectonic motion -- enormous continental plates that move slowly over an underlying magma -- the Magellan team found little evidence of plate tectonics on Venus. One possible exception is the Ovda region at the western end of the equatorial Aphrodite Terra highlands.

"In this region we see what appear to be the closest thing on Venus to Earth's continents," said Saunders. "It has features that seem to have been formed by compression of the Venusian crust in a process that may resemble some plate tectonic regions on Earth."

Saunders said that Ovda and similar terrains -- called tesserae, are intensely fractured regions that are pushed upward compared with most of the planet -- may represent ancient crustal materials on Venus. "They could, in fact, be fragments of the oldest rocks on the planet," he said.

During Magellan's fourth 8-month orbital cycle which ended May 25, flight controllers collected gravity data by monitoring the frequency of the signal sent to Earth from the spacecraft. Changes in the gravity field would make Magellan speed up or slow down slightly, causing the frequency of its signal to change by tiny fractions.

During that cycle, however, Magellan was in a widely looping elliptical orbit, a 100 miles (170 kilometers) by 5,300 miles (8,500 kilometers). Because of the varying distance, Magellan could collect high-resolution gravity data at the equator but not near the poles.

If successful, the aerobraking maneuver will put Magellan into an orbit 125 by 375 miles (200 by 600 kilometers) above Venus. The change will be made gradually over the course of about 70 days.

The change in orbit also will provide important new data about Venus' atmosphere which can be studied through its effect on the spacecraft. The upper atmosphere varies with the 11-year cycle of sun activity. "We currently are approaching a solar minimum which means that the number of sunspots and solar storms will be at a minimum," said Saunders.

Magellan has fulfilled all of its prime mission objectives, mapping 98 percent of the surface of Venus with many areas covered up to three times. "This provides us with stereo imaging," said Saunders, "as well as a long-time base so that we can search for surface changes in the high-resolution images."

-end-

EDITORS NOTE: Photographs are available to the media from NASA's Broadcast and Imaging Branch, 202/358-1900.

B&W: 93-H-195 thru 1204 Color: 93-HC-182 thru -189

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 358-1600

Paula Cleggett-Haleim
Headquarters, Washington, D.C.
(Phone: 202/358-0883)

For Release

May 26, 1993
Embargoed until noon EDT

Mary A. Hardin
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

RELEASE: 93-099

VOYAGER SPACECRAFT FIND CLUE TO ANOTHER SOLAR SYSTEM MYSTERY

Nearly 15 years after they left home, the Voyager 1 and 2 spacecraft have discovered the first direct evidence of the long-sought-after heliopause -- the boundary that separates Earth's solar system from interstellar space.

"This discovery is an exciting indication that still more discoveries and surprises lie ahead for the Voyagers as they continue their journey to the outer reaches of our solar system," said Dr. Edward C. Stone, Director of the Jet Propulsion Laboratory (JPL), Pasadena, Calif., and Voyager Project Scientist.

Since August 1992, the radio antennas on the spacecraft, called the plasma wave subsystem, have been recording intense low-frequency radio emissions coming from beyond the solar system. For months the source of these radio emissions remained a mystery.

"Our interpretation now is that these radio signals are created as a cloud of electrically charged gas, called a plasma, expands from the sun and interacts with the cold interstellar gas beyond the heliopause," said Dr. Don Gurnett, Principal Investigator of the Voyager plasma wave subsystem and a professor at the University of Iowa.

The sun is the center of our solar system. The solar wind is a stream of electrically charged particles that flows steadily away from the sun. As the solar wind moves out into space, it creates a magnetized bubble of hot plasma around the sun, called the heliosphere. Eventually, the expanding solar wind encounters the charged particles and magnetic field in the interstellar gas. The boundary created between the solar wind and interstellar gas is the heliopause.

- more -

"These radio emissions are probably the most powerful radio source in our solar system," said Gurnett. "We've estimated the total power radiated by the signals to be more than 10 trillion watts. However, these radio signals are at such low frequencies, only 2 to 3 kilohertz, that they can't be detected from Earth."

In May and June 1992, the sun experienced a period of intense solar activity which emitted a cloud of rapidly moving charged particles. When this cloud of plasma arrived at the heliopause, the particles interacted violently with the interstellar plasma and produced the radio emissions, according to Gurnett.

"We've seen the frequency of these radio emissions rise over time. Our assumption that this is the heliopause is based on the fact that there is no other known structure out there that could be causing these signals," Gurnett continued.

Because of the Voyagers' unique positions in space, they serendipitously detected and recorded the radio emissions. "Earth-bound scientists would not know this phenomenon was occurring if it weren't for the Voyager spacecraft," Gurnett added.

Exactly where the heliopause is remains one of the great unanswered questions in space physics.

"It's this Voyager radio data combined with the plasma measurements taken at the spacecraft that give us a better guess about where the heliopause is. Based on the solar wind speed, the time that has elapsed since the mid-1992 solar event and the strength of the radio emissions, my best guess for the upper limit of the heliopause currently is about 90 to 120 astronomical units (AU) from the sun," said Dr. Ralph McNutt, a co-investigator on the Voyager plasma science experiment and a researcher at the Johns Hopkins University Applied Physics Laboratory in Laurel, Md. (One AU is equal to 93 million miles (150 million kilometers) or the mean distance from the Earth to the sun.)

Voyager 1 currently is at 52 AU (4.9 billion miles or 7.8 billion kilometers from the sun), and Voyager 2 is at 40 AU (3.7 billion miles or 6 billion kilometers) from the sun.

Voyager 1 was launched on Sept. 5, 1977 and completed flyby exploration of both Jupiter and Saturn. The spacecraft now is rising above the ecliptic plane -- the plane in which most of the planets orbit the sun -- at an angle of about 35 degrees at a rate of about 320 million miles (about 520 million kilometers) a year.

Voyager 2 was launched on Aug. 20, 1977 and also completed visits to Jupiter and Saturn and then went on to explore Uranus and Neptune, completing the reconnaissance of the giant outer planets. The spacecraft is now diving below the ecliptic plane at an angle of about 48 degrees and a rate of about 290 million miles (about 470 million kilometers) a year.

Gurnett presented his findings today at a meeting of the American Geophysical Union in Baltimore.

The Voyager Interstellar Mission is managed by JPL for NASA's Office of Space Science, Washington, D.C.

- end -

NASA News

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AC 202 453-8400

ISY

For Release

Ed Campion
Headquarters, Washington, D.C.
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Bruce Buckingham
Kennedy Space Center, Fla.
(Phone: 407/867-2468)

May 27, 1993
6:00 p.m. EDT

LAUNCH ADVISORY - JUNE 3 LAUNCH OF ENDEAVOUR POSTPONED

NASA managers have decided to changeout Space Shuttle Endeavour's #2 main engine liquid oxygen turbopump because of an issue which was raised with a part on the pump. The decision to remove and replace the pump will move the launch of Endeavour on Shuttle Mission STS-57, originally scheduled for June 3, to sometime around mid-June. A firm launch date will be set after the replacement pump has been installed and checked out.

The specific issue with the turbopump is with one of two springs which are designed to keep the pump's ball bearings in place and in their proper positions. During inspection of the pump, engineers discovered evidence of an inspection etch mark in a high-stress region of the spring. While there is data which indicates the spring will work as designed, NASA managers decided to replace the unit since they could not firmly determine that the pump would operate in a safe manner. If a spring were to fail, the rotor position may not be held accurately and the potential exists for higher vibration.

Springs are etched for a variety of reasons. They are marked to document individual serial numbers, to verify that materials penetration inspections have been complete, and/or to note that the part has been used in ground test operations. The misplaced etch mark on Endeavour's engine was a penetration verification stamp.

The pumps on the main engines to be used on the upcoming flights of Space Shuttle Discovery (STS-51/July 1993) and Space Shuttle Columbia (STS-58/Sept. 1993) will be examined as part of their pre-launch processing.

\- end -

NASA News

National Aeronautics and
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For Release May 27, 1993

Michael Finneran
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RELEASE: C93-e

NSI SELECTED FOR NASA CONTRACT NEGOTIATIONS

NASA Goddard Space Flight Center, Greenbelt, Md., has selected NSI Technology Services Corp., Fairfax, Va., for negotiations leading to the award of a cost-plus-award-fee contract for integration and test support services.

The contract, with a 7-year period of performance, has an estimated value of $200 million and will provide services to all of Goddard and portions of NASA's Wallops Flight Facility, Wallops Island, Va.

The contract will provide for on-site engineering support for launch environment simulation, space simulation and operations, integration, certification/recertification and optics. The requirement consists of about 280 person-years for each contractual year.

NSI, the incumbent contractor, was the only company submitting a proposal in response to the request for proposal.

-end-

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May 28, 1993

STS-61

NOTE TO EDITORS: N93-30

HUBBLE SERVICING MISSION WORKSHOP SCHEDULED FOR JUNE 16 - 17

A workshop to brief reporters on all aspects of the first servicing mission for the Hubble Space Telescope will be held at the Goddard Space Flight Center, Greenbelt, Md., on June 16, and at the Space Telescope Science Institute, Baltimore, Md., on June 17.

A preliminary agenda is attached.

For information on lodging and directions, contact the Public Affairs Office at Goddard Space Flight Center, 301/286-6256 and the Space Telescope Science Institute, 410/338-4514.

- end -

2-Day News Writers Conference
Preliminary Agenda
June 16-17, 1993

June 16, Goddard Space Flight Center, Greenbelt, Md.

10:00-10:15	Mission Management	R. Brinkley
10:15-10:30	Mission Objectives	K. Ledbetter
10:30-10:45	Servicing Mission Tasks	J. Rothenberg
10:45-11:00	Redesigned Solar Arrays	ESA Representative
11:00-11:15	Shuttle Mission Preparation	M. Heflin
11:15-11:30	Astronaut's Perspective	*Astronaut*
11:30-11:45	Questions and Answers	Ledbetter, Brinkley, Rothenberg, Heflin, *Astronaut*
11:45-12:00	Break	
12:00-12:15	HST Science Enhancements	E. Weiler
12:15-12:30	Post-Mission Science Verification Program	D. Leckrone
12:30-12:45	Questions and Answers	Weiler, Leckrone
12:45-2:00	Lunch Break	
2:00-4:00	Tours of HST Clean Room, Operations Center	

June 17, Space Telescope Science Institute, Baltimore

8:30-10:00	HST Science Program Status	P. Stockman
	COSTAR	J. Crocker
	WF/PC 2	J. Trauger
10:00-10:15	Break	
10:15-11:30	Expected Improvements in HST Data	C. Burrows
	HST vs. Adaptive Optics	P. Bely
	Improving Data with Reconstruction Techniques	R. Allen
11:30-1:00	Lunch, free time for interviews	
1:00-2:30	HST Science Accomplishments	F. Macchetto
	Galaxy Evolution, Active Galactic Nucleii	H. Ford
	Cosmology	C. Norman
	Stars	F. Paresce
2:30-2:45	Break	
2:45-4:00	Advanced Instruments	R. Brown, R. Thompson, B. Woodgate
	Why HST Must Be Improved	E. Weiler, H. Ford, C. Norman,
	Panel Discussion	R. Brown, P. Stockman

NASA Facts

National Aeronautics and
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Washington, D.C. 20546
AC 202 453-8400

NATIONAL FACILITY STUDY

General

The United States is increasingly challenged by advances in technologies that will affect its global competitiveness in virtually all economic sectors. Preeminent among these are advances in aerospace technology. These advances are paced by modern, highly productive research, development and operational facilities.

The Study

Recognizing this situation, a review has been initiated for the development of a comprehensive long-term plan for future aerospace facilities. This integrated plan is being accomplished in partnership among Government agencies and industry to ensure that the facilities are world-class and to avoid unnecessary duplication of effort. The plan will be available in early 1994.

The plan will include a requirements analysis which will consider current and future government and commercial industry needs through the year 2023. It will specifically address shortfalls in existing capabilities, new facility requirements, upgrades, consolidation and phase-out/closure of existing facilities. Recommendations will also include cost impacts, either as investment costs or savings, or any other considerations (e.g., national security concerns, technology transfer, proprietary rights, commercial competitiveness, etc.) that would bear on decisions resulting from this study. Issues such as shared usage, common costing and management operation will also be addressed.

- more -

Organization, Participants

The Oversight Group, which has responsibility for implementing this study, is chaired by NASA, vice-chaired by the Department of Defense (DoD) and includes representatives from other involved agencies: the Departments of Energy (DoE), Transportation (DoT), Commerce (DoC) and the National Science Foundation (NSF). The Study Director has responsibility for executing the plan. He is responsible for conducting the study and its schedule, coordinating participation, integrating all inputs, preparing the final products and providing those products to the Oversight Group.

Four Task Groups, co-chaired by NASA and DoD, have been established to assist the Study Director: an Aeronautics R&D Task Group; a Space R&D Task Group; a Space Operations Task Group, and a Facilities Costing and Engineering Task Group. Participating agencies are providing representatives to the Task Groups.

- end -

* *

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June, 1993

NASA News

National Aeronautics and
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For Release

June 1, 1993

RELEASE: 93-100

NASA TO COMMERCIALIZE REMOTE-CONTROL TECHNOLOGY

A remote-control technology used by NASA scientists to guide a robot in a recent cross-country test soon will be turned over to private industry.

The remote-control technology is being licensed to a private firm for commercial development, said Dr. Antal Bejczy, the experiment Technical Manager at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif. The firm's identity is being withheld while negotiations are in progress.

In the test, researchers at JPL used a new, graphically-oriented program to remotely control -- or "teleoperate" -- a robotic arm at NASA's Goddard Space Flight Center, Greenbelt, Md.

This teleoperation technique is designed for free-flying robots that would service orbiting satellites, and also has many potential uses on Earth, according to Bejczy.

Possible terrestrial applications for teleoperations include nuclear or toxic waste site cleanup, decommissioning of hazardous facilities, special emergency medical operations, construction and building planning, and remotely operated highway maintenance.

In the recent JPL-Goddard experiment, a robot arm equipped with a power screwdriver was placed in front of a mockup of a satellite at the Goddard center. The satellite was fitted with a replaceable module designed to be changed out by astronauts or robots.

- more -

The robot arm's job was to insert the screwdriver through a 18-inch (45-centimeter) long hole to reach a latching mechanism that holds the replaceable module on the satellite, then to unlatch and remove the module. Finally, the robot arm was to place the new module on the satellite's frame and latch it in place.

Throughout the experiment, the arm was controlled by an operator thousands of miles away in California.

JPL researchers developed a software program that allows the remote operator to superimpose high-fidelity computer graphics models of the robot arm, screwdriver and satellite module onto television pictures of the live scene.

These synthetic TV camera views make visible the robot's critical motion events that otherwise are hidden from the operator in a normal TV camera view, said Bejczy.

"The operator can generate and predict or preview the motions without commanding the actual hardware," said Bejczy. "Moreover, the operator can see the consequences of motion commands in real time, without time delay, through the simulation method overlaying the actual work scene."

After verifying an action of the robot arm and its result through the synthetic TV view, the operator then commands the robot arm and tool to actually execute the next action.

During the test, computer commands were sent from JPL to Goddard over the Internet computer network. TV views of the robot arm and satellite mockup were sent back to the JPL control station over NASA's satellite TV system.

"The module exchange task was originally designed to be performed by astronauts working in pressurized suits in the Space Shuttle's cargo bay," said Bejczy. "The success of the experiment shows that the same work can be done by robotic hardware controlled from Earth."

Bejczy also said that the graphics-based, remote-control technique will form the basis for new features added to commercially available computer graphics software packages.

JPL's work on this experiment is being performed with funding from NASA's Office of Advanced Concepts and Technology, Washington, D.C.

- end -

NASA News

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For Release

June 1, 1993

RELEASE: 93-101

BIENNIAL ASTRONAUT RECRUITING BEGINS

NASA is accepting applications for mission specialist and pilot astronaut positions effective immediately. Interested individuals may apply until the cut-off date of July 1, 1993. Applications received after the deadline will be eligible for consideration in the next selection cycle.

Successful pilot applicants typically have extensive piloting experience in high-performance jet aircraft and flight test experience. Successful applicants for the mission specialist positions typically have significant backgrounds in the sciences (materials science, Earth science, medical science and space science) or engineering.

After a 6-month process including screening applications and conducting interviews and medical evaluations, selections will be announced in the spring of 1994 with the new astronaut candidates reporting to the Johnson Space Center, Houston, in July 1994.

"We are looking for multi-faceted individuals who are not only outstanding in their chosen disciplines but who will be able to handle various technical assignments, maintain spacecraft systems and experiments, work well with others and have excellent communications skills. We also like to have a balanced skill mix and a culturally diverse group in the astronaut corps," Director of Flight Crew Operations David C. Leestma said.

An application package may be obtained by writing to:

NASA Johnson Space Center
Attn: AHX Astronaut Selection Office
Houston, TX 77058

- end -

NASA News

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AC 202 453-8400

ISY

For Release

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June 2, 1993

NOTE TO EDITORS: N93-31

STATION REDESIGN ADVISORY COMMITTEE MEETING SCHEDULED

The Advisory Committee on the Redesign of the Space Station, headed by Dr. Charles M. Vest, will hold an open meeting on Monday, June 7, 1993, at the Stouffer Concourse Hotel Admiralty Ballroom, 2399 Jefferson Davis Highway, Arlington, Va., from 9:30 a.m. to 5:00 p.m. EDT.

Subjects to be discussed may include options update and assessment; operations; and international partners' assessments.

- end -

NASA News

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Washington, D.C. 20546
AC 202 358-1600

For Release

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June 2, 1993

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RELEASE: 93-102

SHUTTLE TILE MATERIAL MAY HELP IN BONE TRANSPLANTS

The same material that keeps the Space Shuttle from burning up when it returns from space may be useful in treating medical problems on Earth.

Researchers from NASA's Ames Research Center, Mountain View, Calif., are working with physicians from BioMedical Enterprises Inc. and the University of Texas Health Science Center, both of San Antonio, to determine whether the Space Shuttle's ceramic surface insulation materials can be used as an implant for human skeletal reconstruction.

"We're still a long way from having a bone implant that's ready for human use," said Howard Goldstein, Senior Staff Scientist in Ames' Thermosciences Division. "But we have data that show the tile material has excellent promise for use as a bone implant."

Goldstein led the research, development and evaluation of the ceramic, known as Reusable Surface Insulation (RSI), in the 1970s and 1980s. He also will lead Ames' RSI research team on the new project.

Tiles made of RSI cover the Space Shuttle and keep it from burning up when it re-enters Earth's atmosphere. "The theoretical attraction of Shuttle insulation is that it is biocompatible," said Dr. Dani Goldwater, Manager of commercial space programs at Ames. "It also provides a porous framework, which allows infiltration by normal bone cells and deposition of bone mineral. The result could be complete integration of the implant into normal bone," she said.

- more -

Goldstein cautioned, however, that "a lot remains to be done before we can demonstrate the many potential uses of RSI as a bone implant." For example, scientists must improve the material properties of the ceramic fiber composite. They also will have to increase the pore size of the material for use as a bone scaffolding, while increasing its strength and maintaining biocompatibility.

Dr. Casey Fox, BioMedical Enterprises Inc., and Dr. Thomas Aufdemorte, University of Texas Health Science Center, first must determine the safety, efficiency and applications for these materials as bone implants. After developing and testing the product in the laboratory, they will work to get U.S. Food and Drug Administration approval for use in humans. Fox expects the development, testing and market approval process to take about 6 years.

If tests are successful, "the ultimate result of this research might be the production of implants that can substitute for or supplement natural bone," Fox said. "The contribution to the relief of human suffering is potentially enormous."

Fox said physicians perform between 1.2 million and 1.7 million orthopedic and dental procedures each year that could benefit from the availability of the bone implant material. People with bone disorders resulting from trauma, disease and degenerative skeletal changes associated with aging are likely to benefit from successful development of this bone implant, he said.

"The successful development of RSI technology as a bone implant material could lead to major improvements in the initial and long-term viability of bone implants," Fox said. He expects the new bone implant to be used with implants such as metal pins, wires, plates and screws when treating a fracture. Physicians also may use it instead of bone transplanted from humans, thereby preventing disease transmission.

"After healing within and around the porous implant, the result could be a fiber-reinforced bone," Fox said. In addition, he expects the porosity and surface chemistry of the ceramic material to allow administration of medicines that promote bone healing.

RSI is a silica, alumina fiber and borosilicate glass composite that can be adapted to mimic the structure of bone. Dr. Daniel Leiser, assistant chief of Ames' Thermal Protection Materials Branch, will lead Ames' effort to refine RSI for the bone implant study. The goal is to produce a high-purity, large porosity, low-density, high-strength ceramic fiber composite.

"This research team combines the unique talents of three groups," Goldstein said. "The skills of Ames' Thermosciences Division in developing composites and processes will join with university-based clinical medical expertise and the biomaterials and implant design skills of private industry."

Ames scientists will develop processing methods to produce ceramics that meet the requirements for pore size, strength and biocompatibility. Fox and Aufdemorte will study the performance of ceramic materials as implants in the laboratory, which may include experiments on future Space Shuttle flights. They have shown that RSI materials appear to be biocompatible and potentially useful for oral and general skeletal trauma and reconstructive treatment.

- end -

NASA News

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For Release

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June 3, 1993

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RELEASE: 93-103

NASA TESTING NEW, POWERFUL DUCTED FANS ENGINE FOR CIVIL JETS

NASA has begun testing a powerful, new engine developed for large subsonic passenger jets that could cut fuel consumption 10 to 12 percent and significantly reduce engine noise.

"By the turn of the century, the Advanced Ducted Propulsor (ADP) should be ready for use in 300-to-700 seat commercial transport aircraft," said Dr. Clifton Horne, Project Director at NASA Ames Research Center, Mountain View, Calif., site of the testing.

The ADP features a large, variable-pitch fan system, a 40,000 horsepower fan-drive gear system and a new, high-speed, low-pressure turbine. The engine has a maximum forward thrust of more than 50,000 pounds.

The ADP's variable-pitch fan system, which is nearly 10 feet (3 meters) in diameter, places its 18 fan blades in the most efficient position for take off, cruising and reverse thrust.

"This ends the need for thrust reversers normally used to slow down an aircraft after landing," Horne said. "Elimination of thrust reversers can provide weight, reliability and cost benefits unattainable with conventional fixed-blade turbofans."

The joint NASA/Pratt & Whitney project is part of NASA's research program in subsonic aircraft technology to develop technologies, in cooperation with the aerospace industry, that make possible significant improvements in aircraft performance and ensure that U.S. air transportation remains competitive worldwide.

- more -

The full-size ADP "demonstrator" engine was developed by Pratt & Whitney, a division of United Technologies Corp., Hartford, Conn., with Motoren-und Turbinen-Union of Munich, Germany, and Fiat Avio of Turin, Italy.

Turbojet engines generate thrust by pushing high speed air through the compressor, combustion chamber and turbine. In a turbofan, the turbine also drives a large fan. The fan produces thrust more efficiently and quietly by pushing through more air at lower speeds.

Tests in the NASA wind tunnel will continue 9 hours a day for 12 weeks. The goals include confirming the engine's thrust reverse capability.

"Tests will center on simulated landing conditions, with primary emphasis on confirming thrust reverse under variable pitch in 120-to-140-knot winds," Pete Zell, Ames' Test Director said.

ADP is the largest engine ever tested in Ames' National Full-Scale Aerodynamics Complex (NFAC) wind tunnel. "The NFAC is the only facility capable of simulating flight conditions and thrust reversal for this engine," said Horne.

Pratt & Whitney first tested the ADP last fall at its West Palm Beach, Fla., facility. Those tests confirmed the engine's operation without forward wind speed. Pratt & Whitney tested a one-seventh-scale model of the ADP at NASA's Langley Research Center, Hampton, Va., in 1992 and at Lewis Research Center, Cleveland, in 1991.

- end -

NOTE TO EDITORS: A video clip showing the ADP in Ames' 40-by-80-foot wind tunnel is available to media by calling 202/358-1733. Still photos also are available to the media by calling 202/358-1900.

Color:	B&W
93-HC-194	93-H-210

NASA News

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For Release

June 4, 1993

RELEASE: 93-104

STATION REDESIGN TEAM TO SUBMIT FINAL REPORT

The Space Station Redesign Team, comprised of representatives from NASA and the international partners, will submit its final report on three space station options to the White House Advisory Committee on the Redesign of the Space Station on Monday, June 7, at the Stouffer Hotel in Crystal City, Va.

The three options, the results of nearly 3 months of intensive research and analysis, include a modular concept that would use existing flight-proven hardware, a derivative of the current Space Station Freedom design and a space station that could be placed into orbit with a single launch of a Shuttle-derived vehicle.

"The Team has done a tremendous job," said NASA Administrator Daniel Goldin. "They have developed 3 technically viable space stations. Each provides for international cooperation, establishes a fully-capable space research center in orbit that will enable high priority science, technology and engineering research and in every case, do it for significantly less money than the current Space Station Freedom baseline."

"The cost estimates provided by the Redesign Team reflect complete and accurate costs of each option and the current Space Station Freedom design," Goldin said.

The baseline Freedom cost numbers were subjected to rigorous review by an expert NASA team working apart from the Freedom program. Those results, plus the costs of the three space station options, are being reviewed by an experienced, independent cost analysis team created by the White House advisory committee.

"The estimates are honest and defensible. They provide a solid basis for decision because they are comprehensive and compare all options on an apples-to-apples basis," Goldin said. "Our books are open and will withstand the closest scrutiny."

- more -

President Directs Redesign

An assessment early in 1993 by the incoming Administration determined the increases in the Space Station Freedom budget in the outyears would not fit within the expected NASA budget, which the Administration planned to cut by about 15 percent over the next 5 years in the interest of federal deficit reduction. The White House also wanted to place increased emphasis on other NASA programs such as aeronautics and science.

Rather than cancel the program, President Clinton directed NASA to redesign the space station and produce a configuration that would significantly reduce development, operations and utilization costs, while at the same time honor the United States' commitments to the international partners and provide the essential resources to advance the nation's scientific and technology development capabilities in space.

The Station Redesign Team also was charged with recommending new and streamlined management structures and acquisition strategies and to develop operational concepts that would cut operations costs in half.

Monday's meeting will be the third and final public meeting with the Advisory Committee. Chaired by MIT President Dr. Charles Vest, the 16-member Advisory Committee will provide an independent assessment of the designs, cost, proposed management structure and the operations plan, and forward that assessment to the President on or about June 10.

"The objective of the redesign team was to develop options for a redesigned space station," said Goldin. "The team was not asked to recommend one option over the others but rather to characterize each design's strengths and weaknesses in an unbiased manner."

Directed by Deputy Associate Administrator for Space Flight and former astronaut Bryan O'Connor, the NASA team was led by a core group of about 36 people. The diversified team had at least one representative from each NASA center, several scientists and engineers with backgrounds that ranged from program managers to spacecraft designers.

Ten representatives from the international partners - the European Space Agency, Japan and Canada - and from Italy formed the remainder of the core team. Consultants from other government agencies and from industry served as advisors to the group. The core team, working in Crystal City, Va., received technical support on each of the options by people from across NASA.

Station Objectives Outlined

Goldin provided specific objectives and constraints, reflecting guidance from the Administration, to the team in an implementation letter of March 9, 1993. In the letter, Goldin stressed that the redesigned space station must:

- Provide a cost effective solution to basic and applied research challenges whose merit is clearly indicated by scientific peer review, significant industrial cost sharing or other widely accepted method;

- Provide the capability for significant long-duration space research in materials and life sciences during this decade;

- Bring both near-term and long-term annual funding requirements within the constraints of the budget;

- Continue to accommodate and encourage international participation; and

- Reduce technical and programmatic risk to acceptable levels.

Other directions to the team from Goldin included constraints or objectives of greatly reducing on-orbit assembly and checkout; planning for a shorter on-orbit lifetime (e.g., 10 years extendible to 15 years); greatly reducing the number of Shuttle launches and extravehicular requirements for deployment; advancing the permanently manned capability date; and reestablishing national leadership in space.

In addition, the team was directed to give consideration to greater use of Shuttle and Spacelab capabilities (which may be modified to allow longer stays in orbit) and the Russian Mir space station.

Budget Guidelines Set

In addition, Dr. John Gibbons, the President's Science Advisor, provided budget guidance for the Advisory Committee to use in their deliberations. For the 5-year period from Fiscal Years 1994 to 1998, NASA was to assume a low option of $5 billion, a mid-range option of $7 billion and a high option of $9 billion.

Activities which were to be paid for within the $5 billion, $7 billion and $9 billion accounts included: space station development, operations, utilization (including building science experiments and other payloads for the station and for Spacelab as well as the ground infrastructure to manage and deliver data to the users), Shuttle integration, facilities, research operations support, termination costs, transition costs and an appropriate level of reserves.

Three Main Options Evolve

Option A is a modular build-up configuration which uses a combination of Space Station Freedom hardware and flight-qualified space systems from other sources, including the potential use of a self-contained DoD spacecraft called "Bus-1" to provide propulsion, guidance, navigation and control. Option A includes a RBus-1S configuration and a configuration without "Bus-1." Option A has four distinct phases of buildup including: Power Station (1 photovoltaic(PV) array on-orbit for increased power to a docked orbiter/Spacelab); Human Tended Capability (adds U.S. laboratory); International Human Tended (adds an additional PV array and international elements); and Permanent Human Capability (adds third PV array, the U.S. habitat module and two Russian Soyuz ACRVs).

Option B is derived from mature Space Station Freedom designs. It makes maximum use of current systems and hardware to provide an incrementally increasing capability, emphasizing accommodations for users, adherence to international partner commitments, flexibility and growth potential, and recommends some system changes to save money. Like Option A, the Freedom-derived option is built up over 4 stages. From an assembly sequence standpoint, the primary difference between the Option A and B is that the Freedom-derived configuration adds the third PV array before the international partner elements are added.

Option C is a single-launch space station. This configuration features a 92-foot-long, 23-foot-diameter core module launched as part of a Space Shuttle vehicle and uses an existing external tank, solid rocket boosters and Shuttle main engines. The module would provide 26,000 cubic feet of pressurized volume, separated into 7 "decks" connected by a centralized passageway. Seven berthing ports would be located on the circumference of the module to place the international modules and other elements.

"Each option is capable of accomplishing the mission of the space station," said Goldin. "All of them offer significant scientific and engineering research capabilities, especially in their permanently human presence stages."

Goldin said all the options also would:

- make maximum use of Space Station Freedom systems and components, which have completed a rigorous critical design review, where it is both cost effective and schedule enhancing, thus benefiting from the nation's investment to date in the Freedom program;

- incorporate changes that would reduce complexity and increase the probability for meeting cost and schedule;

- achieve substantial savings through a streamlined management structure that provides clear lines of authority, reduces overlap and gives accountability and authority to the lowest level to get the job done; and

- benefit from a new operations approach that would significantly reduce operational costs.

Goldin said Russian hardware alternatives, where it could benefit the redesigned space station program, also were investigated. In all three options, the Soyuz crew return vehicle has been baselined as the assured crew return vehicle. Launch capability and other systems developed and in operation in the Russian space program are described in the report and will be considered for use in the redesigned space station or in future improvements.

- end -

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For Release

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Bruce Buckingham
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June 7, 1993

LAUNCH ADVISORY

NASA SETS JUNE 20 AS NEW DATE FOR THE STS-57 SHUTTLE MISSION

NASA managers today set June 20, 1993, as the new launch date for the next flight of the Shuttle system. The STS-57 mission will see Space Shuttle Endeavour and her six person crew conduct a mission highlighted by the retrieval of the European observation satellite EURECA and the first flight of the commercial spacelab facility Spacehab.

The launch window on June 20 opens at 9:37 a.m. EDT and extends for 1 hour and 11 minutes. The limited launch window time is based on EURECA retrieval requirements. The mission duration is planned for 7 days. However, it may be extended by 1 day immediately after launch if projections calculated at that time for electrical power consumption permit an extra day in space. The extra day will give two members of Endeavour's crew the opportunity to perform an extravehicular activity (EVA) or spacewalk.

The decision to go with a June 20 date follows the completion of work to remove and replace the liquid oxygen turbopump from Endeavour's #2 main engine. The pump was changed out because of an issue which was raised with a part on the pump. The decision to remove and replace the pump delayed the launch of Endeavour which was originally scheduled for June 3.

This will be the fourth flight of Space Shuttle Endeavour and the 56th flight of the Space Shuttle system.

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For Release

Paula Cleggett-Haleim
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(Phone: 202/358-0883)

June 7, 1993
Embargoed Until 2:30 p.m. EDT,

Randee Exler
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(Phone: 301/286-0697)

RELEASE: 93-105

NEW DISCOVERIES BY NASA'S EUV EXPLORER PRESENTED

Recent discoveries from NASA's Extreme Ultraviolet Explorer (EUVE) will be presented June 7 and 8, 1993, at the 182nd National Meeting of the American Astronomical Society (AAS), University of California at Berkeley following the 1-year anniversary of EUVE's launch.

The new results include discovery of elements that blanket the light from white dwarf stars, the detection of ionized helium in the local interstellar gas, the detection of an extreme ultraviolet shadow in the local interstellar medium and new findings on the mysteries of rare extragalactic objects.

The astronomers will discuss why hot white dwarf stars emit only small amounts of extreme ultraviolet radiation, despite that their high temperatures should make them produce large amounts of EUV radiation. EUVE data reveal that unexpected elements - mostly iron - may work as a blanket which blocks the EUV radiation and prevent it from escaping into space.

This information promises important new results about the evolution of stars into the white-dwarf stage and may help astronomers calculate the details of how stars age and die, as our the sun will die when it becomes a white dwarf in about 5 billion years, according to the astronomers.

What physical conditions describe the gas surrounding this solar system? The EUVE has allowed astronomers for the first time to observe ionized helium (helium atoms that have lost one of their two electrons) in the gas that floats among the sun and nearby stars. The EUVE satellite's observations may soon yield far better measurements of the density, temperature and ionization state of this interstellar gas than have been possible until now.

- more -

The Deep Survey Telescope on board EUVE has obtained the first direct evidence that the gas and dust drifting among the stars in this galaxy emit a faint glow in the EUV. EUVE observed an EUV "shadow" cast by this gas and dust cloud. The cloud lies in the direction of the constellation Taurus and is believed to be approximately 200 light-years away. Its location indicates to astronomers that the hot, ionized gas of the local interstellar medium extends much farther than previously thought.

Unraveling the Nature of Extragalactic Objects

The first sky survey ever conducted in the entire EUV band of the electromagnetic spectrum has revealed that some of the rarest, most exotic objects in the universe -- BL Lacertae Objects (BL Lacs) -- are surprisingly visible in the EUV. The finding, which will be discussed at this meeting, brings scientists one step closer to puzzling out the mysterious nature of BL Lacs.

BL Lacs are comparatively rare and are theorized to be centered on massive black holes. By analyzing the EUV light given off by these objects, scientists may learn more about the composition and velocities of matter entering possible black holes.

Active galactic nuclei (AGN) are another class of rare extragalactic objects to be discussed at this meeting. Many of the AGNs seen in previous surveys either were detected weakly or not observed at all in the EUV. EUVE has revealed that some AGNs are visible in the EUV because their central source of energy is powerful enough to clear a path through the surrounding, otherwise opaque neutral gas.

The EUVE was launched June 7, 1992 to make the first survey of the universe at all the wavelengths contained in the EUV band of the spectrum. The Center for Extreme Ultraviolet Astrophysics (CEA), under contract to NASA's Goddard Space Flight Center, Greenbelt, Md., serves as the Science Operations and Data Analysis Facility for EUVE. EUVE is part of NASA's Office of Space Science's Explorer program in Washington, D.C.

- end -

EDITORS NOTE: Guest observers and astronomers from the CEA in Berkely will present the new results during a press conference on June 7 at 2:30 p.m. EDT. The AAS press room, located in the West Madrone Room, Student Union, University of California at Berkeley, opens 1 p.m., June 6. Media needing assistance may call (510) 643-7070, -7120 or -7137.

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NOTE TO EDITORS: N93-032

NEW NASA MANIFEST AVAILABLE

An updated NASA manifest of future Shuttle and unmanned launches is now available to members of the news media. The 1993 Payload Flight Assignments NASA Mixed Fleet includes payload flight assignments for the Space Shuttle through Fiscal Year 1995 and NASA Expendable Launch Vehicle (ELV) missions through FY 1999.

Copies of the manifest are available to the news media by writing to NASA Headquarters, News & Information Branch, Mail Code PM, Washington, D.C. 20546 or by calling 202/358-1600.

- end -

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RELEASE: 93-106

NASA USES NEW METHOD TO DETECT NEW STARS AND PLANETS

NASA astronomers investigating how stars are born have used a new approach to observe the motion of multiple clumps of interstellar gas that are on the verge of becoming new stars and planetary systems.

This experiment was performed with the new instruments developed for NASA's High Resolution Microwave Survey (HRMS), which is searching for radio signals that may be coming from technological civilizations on planets orbiting distant stars.

HRMS is part of NASA's Toward Other Planetary Systems (TOPS) program, which is designed to find and study planets forming around other stars.

The Milky Way galaxy contains large, massive interstellar clouds of gas which are the nurseries for newborn stars. Astronomers believe gravity causes these clouds to collapse and fragment and produce smaller, dense clumps of gas. In time, these clumps collapse to form protostars and ultimately, stars and planetary systems.

"We hope that by finding and characterizing these small, dense clumps of gas we can understand the star formation process and why different types of stars evolve," said Dr. Thangasamy Velusamy, a member the research team at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif.

One way to study interstellar clouds is to detect the radio emissions produced by a variety of molecules found in the gas clouds.

- more -

The JPL scientists observed that radio emissions from a carbon-sulfur chain molecule, called CCS, stand out much more clearly in some of these gas clumps.

"We found that these parcels of gas have very little or no internal motion, other than random motions of individual molecules at very low temperatures (20 degrees K). For this reason we believe that we are seeing the basic cloud fragments from which stars may form," said Dr. William Langer, leader of JPL's Radio Astronomy Group.

To detect the radio waves in the star-forming clouds, scientists used the large 230-foot (70-meter) radio telescope at NASA's Deep Space Network in Goldstone, Calif., in conjunction with the 2 million channel wide-band spectrum analyzer that is the heart of the HRMS sky survey system.

"What made our observations unique was that we were able to take advantage of the HRMS spectrum analyzer to separate out the motions of individual clumps of gas, which gave us unprecedented velocity resolution," said Langer.

"Using this instrument with the large radio telescope allows us to detect small scale structure in a star-forming region and study their motions with respect to one another. This is especially important to resolve the questions of how stars form and why some stars form alone, while others form companion systems orbiting one another," Langer continued.

In collaboration with Langer and Velusamy, Drs. Thomas Kuiper, Steven Levin and Edward Olsen presented their findings before the 182nd national meeting of the American Astronomical Society at the University of California at Berkeley.

Velusamy, Director of the Ooty Radio Observatory in India, is on sabbatical leave as a U.S. National Research Council senior resident research associate at JPL.

The research performed by JPL's Radio Astronomy Group was conducted under contract with NASA. HRMS is sponsored by the Solar System Exploration Division, Office of Space Science, NASA Headquarters, Washington, D.C.

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RELEASE: 93-107

EVIDENCE FOR SOLID WATER FOUND ON JUPITER'S MOON IO

Scientists have found water molecules frozen in the surface ices of Jupiter's moon Io.

"This is the first strong evidence of solid water on the surface of this satellite," said Dr. Farid Salama, University of California, Berkeley, who led the project at NASA Ames Research Center, Mountain View, Calif.

The absorption lines for water were found in the infrared spectrum of Io by scientists onboard NASA's Kuiper Airborne Observatory (KAO). The KAO has a unique ability to conduct infrared astronomy while flying above 99 percent of Earth's atmospheric water vapor.

"We have finally seen the spectral signature of something for which we've been looking for years -- water on Io," said Dr. Jesse Bregman of Ames Research Center, who developed the spectrograph used with the KAO telescope.

Io is the only body in the solar system, except Earth, known to have intense volcanic activity. The Voyager spacecraft discovered active volcanoes on Io more than a decade ago. Patches of sulfur and sulfur dioxide frosts cover the satellite. The water ice is combined with the more abundant sulfur dioxide ice on Io's surface.

Scientists know that Io's thin atmosphere consists mainly of gaseous sulfur dioxide, but they have been uncertain about the main components of its surface. Their most fundamental question concerned the basic element, hydrogen, Salama said.

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"Although most of Jupiter's satellites are covered with water ice, we assumed that the 'hot', volcanically active moon Io had lost all of its original water through vaporization and escape of the gas molecules from the surface," Sandford said.

Working with Salama and Bregman in detecting the solid water were Drs. Louis Allamandola, Scott Sandford, Fred Witteborn and Dale Cruikshank of Ames Research Center.

Laboratory work on planetary ices done by Salama, Allamandola and Sandford in 1988 first suggested the presence of water on Io. Their studies were initially performed to explain weak bands in the spectra of Io obtained at ground-based observatories by Witteborn, Cruikshank and Bregman.

"Our lab work indicated that the weak bands were due to small amounts of solid water mixed with the dominant frozen sulfur dioxide.

We predicted that a stronger band could be found by telescope observations above Earth's atmospheric water vapor," Salama said. "The presence of water on Io raises important questions about the source of the hydrogen," said Cruikshank, an expert in solar system objects and among the first to identify frozen sulfur dioxide on Io.

"We want to know whether volcanic vents release the hydrogen or if proton bombardment produces it within the frozen sulfur dioxide layer," he said.

"Our favored picture is that the water results from volcanic activity on Io and that some water vapor venting occurs, leading to a mixing with sulfur dioxide in the vent. When the hot gas mixture expands out of the vent it condenses into ices that fall back onto Io's cold surface," said Allamandola.

"Studying the variation of water ice on Io with time and longitude would tell us if the water correlates with volcanic activity. We also need to look at the finer structural details of the new band in Io's spectrum to understand its thermal history and water concentrations," Salama said.

NASA's planned next generation airborne observatory -- the Stratospheric Observatory for Infrared Astronomy -- would give us the higher resolution spectra we need," Witteborn said.

The results are being presented today to the American Astronomical Society meeting in Berkeley, Calif., and have been submitted to the journal Icarus. This research was supported by the Space Sciences Division at Ames and the Office of Space Science, NASA Headquarters, Washington, D.C.

- end -

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June 9, 1993
EMBARGOED UNTIL 1:00 p.m. EDT

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RELEASE: 93-108

HUBBLE CLOSING IN ON AGE OF THE UNIVERSE

Astronomers working with NASA's Hubble Space Telescope today announced results of a major step to measure the Hubble Constant and the age of the universe.

The team has discovered Cepheid (variable) stars in its first target, the spiral galaxy M81, and measured the distance of the galaxy to be 11 million light years. They quote a 10 percent uncertainty in this result (plus or minus approximately one million light years). Previous estimates of the galaxy's distance have ranged from 4.5 to 18 million light years.

Cepheids are pulsating stars that become alternately brighter and fainter with periods ranging from 10 to 50 days. Astronomers have known for over 50 years that the periods of these stars precisely predict their total luminous power, which allows their distance to be measured.

The Hubble Constant (H0) is the ratio of the recession velocities of galaxies to their distances in the expanding universe. The age of the universe can be estimated from the Hubble Constant and currently is thought to lie between 10 and 20 billion years. A more precise measurement of the Hubble Constant is required to narrow this range.

Team member Dr. Wendy Freedman of Carnegie Institution of Washington said, "In our two observed fields in M81, we have found a total of 32 Cepheids. Decades of previous work from the largest ground-based telescopes have only succeeded in measuring periods for two Cepheids. HST's superior resolution and its ability to schedule observations when and where they are required give HST a special advantage in this work."

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Messier 81 is a large spiral galaxy in the constellation Ursa Major. It is a rotating system of gas and stars similar to the Milky Way galaxy, but approximately twice as massive. This galaxy achieved prominence 3 months ago when the brightest northern supernova of this century was discovered.

The astronomers used the Hubble's Wide Field & Planetary Camera to study two fields in M81. In each field they took 22 20-minute exposures spread over 14 months to find the variable stars and measure their periods and brightness.

The project is one of several so-called "key projects" designated top priority scientific goals for the Hubble Space Telescope. This extragalactic distance scale key project aims to discover Cepheids and measure the distances to galaxies to determine an accurate value of the Hubble Constant.

Dr. Jeremy Mould, Principal Investigator for the team, said, "This is the first step in a major program of measuring distances of galaxies with the Hubble Space Telescope. When the telescope is serviced later this year, and the new Wide Field & Planetary Camera is installed with its corrective optics, we plan to use the same technique on galaxies up to 50 million light years away, which will allow us to measure the Hubble Constant, the rate of expansion of the universe.

"We have 3 years of work ahead of us and, until the project is substantially complete, I won't speculate on what value of H0 this work will yield."

Although this HST key project has the explicit goal of getting H0, other astronomers have used Hubble to search for Cepheids. Previous HST observations carried out by a different group also demonstrated HST's unique capability by resolving 27 Cepheids in another galaxy.

The announcement was made at the 182nd meeting of the American Astronomical Society in Berkeley, Calif. The results are detailed in several presentations by team members at that meeting and are being submitted for publication in the Astrophysical Journal.

The team, led by Jeremy Mould (California Institute of Technology, Pasadena, Calif.), consisted of Sandra Faber and Garth Illingworth (Univ. of California, Santa Cruz); Wendy Freedman, John Graham and Robert Hill (Carnegie Institution of Washington); John Hoessel (Univ. of Wisconsin, Madison); John Huchra (Center for Astrophysics, Cambridge, Mass.); Shaun Hughes (Caltech) (Univ. of Calif., Santa Cruz); Robert Kennicutt (Univ. of Arizona, Tuscon); Myung Gyoon Lee (Carnegie); Barry Madore (Caltech); Peter Stetson (Dominion Astrophysical Observatory, Victoria, British, Columbia); Anne Turner (Univ. Arizona, Tuscon); and Laura Ferrarese and Holland Ford (Space Telescope Science Institute, Baltimore).

- end -

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RELEASE: 93-109

HUBBLE FINDS EVIDENCE OF STELLAR CLOSE ENCOUNTERS

NASA's Hubble Space Telescope (HST) has discovered a group of stars that apparently have been canabalized of their cooler outer gas layers by other passing stars, resulting in stellar "naked cores" with surface temperatures five times hotter than Earth's sun.

"This is amazing. These objects represent a totally new population of very blue stars," says Guido De Marchi, of the Space Telescope Science Institute (STScI), Baltimore, Md., and the University of Florence, Italy. "When we started wondering what they could be, we realized that they may be among the first observed stars to have been stripped."

The stars are located deep in the core of M15, one of the densest globular clusters known. A globular cluster is a "beehive swarm" of several hundred thousand stars held together by each other's gravity. If the cluster is exceptionally dense, chances are increased for close encounters of stars, in which bodies with strong gravitational attraction could strip other stars of their outer material.

"If our planet were there, we would see 100,000 stars closer than Proxima Centauri, the closest star to Earth's sun," said De Marchi. "The night sky would look simply fantastic."

De Marchi and Dr. Francesco Paresce of the European Space Agency, explain that this could only have happened if stars are so crowded together in the core they can be stripped of much of their gaseous envelopes by the gravitational pull of bypassing stars.

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This stellar cannibalism could only take place where stars are so crowded together that chances for close encounters are exceptionally high, they said. De Marchi and Paresce interpret the existence of this new class of stars as possible evidence that the center of the globular cluster has contracted to an extremely dense condition called "core collapse."

This research by De Marchi and Paresce is being announced at a press briefing today at the meeting of the American Astronomical Society in Berkeley, Calif.

The astronomers were surprised to discover about 15 hot blue stars segregated at the very core of M15. Their surface temperatures are above 60,000 degrees Fahrenheit (the sun's surface is 11,000 degrees Fahrenheit).

This discovery was possible only with the Hubble Space Telescope because it can resolve stars at the dense core of M15 that are only a blur from the ground. The observations also required Hubble's sensitivity to ultraviolet light to distinguish the hot stars from the surrounding cooler stars.

Such very hot blue stars can be made in several ways besides stellar stripping, such as magnetically stirred-up super massive stars, white dwarfs, or planetary nebulae. However, the researchers are quick to point out that none of these scenarios explain why the stars are so concentrated and so numerous only at M15's core.

"This rules out a number of other hypotheses," says De Marchi. He explains that all the blue stars lie within a 1 light-year radius at the very core of the cluster. What's more, 90 percent of them are concentrated at the very center of this volume, within a 4/10th light-year radius.

Close Encounters Of The Stellar Kind

According to this scenario, the new population of blue stars was once the cores of red giant stars. Such stars expand to enormous sizes late in their lives, due to changes in the nuclear "burning" at their cores. If the sun were the size of a red giant it would engulf the inner solar system out to the diameter of Mars' orbit.

Red giant stars are so distended that they have a weak gravitational hold on their outer envelope of cool gas. If a normal main sequence star passes within a few stellar radii it can rob gas from the red giant. This stripping process can, in theory, expose a star's core -- the nuclear fusion "engine" that powers stars.

However, conditions where stars are so crammed together are unusual. For example, in the Earth's stellar neighborhood the stars are typically a million times farther apart than the distance between the sun and Earth.

- more -

Conversely, due to the relentless pull of gravity, the stars at the core of M15 have converged so that they are at about 500 times the distance between the Earth and the sun.

The astronomers used Hubble Space Telescope's Faint Object Camera to probe the core of M15 (15th object in the Messier Catalog) which is located 30,000 light-years away in the constellation Pegasus. M15 is visible to the naked eye as a hazy spot 1/3rd the diameter of the full Moon.

Core Collapse

Globular clusters are compact "beehive swarms" of several hundred thousand stars loosely held together under the mutual pull of gravity. The stars are deflected by gravity if they pass near each other. During such close encounters a smaller, less massive star steals momentum from the larger star.

Because of these near-collisions, the massive stars lose momentum and "fall" toward the center of the cluster, like marbles rolling to the bottom of a funnel. Given enough time, massive stars should accumulate at the cluster's center. Theoretically, this could become a runaway collapse where stars quickly crowd together.

Previous Hubble observations suggest that the cluster probably contains powerful energy "storage batteries" in the form of double star systems, which prevent the core from imploding all the way down to a black hole. The rapid orbits of two stars about each other in tight binary systems create a powerful reservoir of kinetic energy. A few double stars can stir up the motion of in-falling stars. This would cause the core to rebound, like squeezing and relaxing a rubber ball.

Astronomers have long sought evidence for core collapse at the heart of very dense clusters like M15. To estimate the true stellar density from ground-based visible light photographs, however, has been difficult. The Hubble observation does not tell whether the core is still collapsing or rebounding.

Previous research by a team led by Paresce found that another class of unusual blue star, dubbed blue stragglers, also dwell at the cores of some clusters. However, even the "stragglers" are not as hot nor as blue as the new population of blue stars in M15. Most of the blue stragglers are probably double stars that gravitationally capture each other. The capture stirs-up the stragglers' nuclear fuel. The star "resets its clock" to relive a bright and hot youth.

The researchers plan to use Hubble to peer into the cores of other globular star clusters to see if this new class of star dwells elsewhere as well.

- end -

NOTE TO EDITORS: A photo to illustrate this release is available through NASA's Broadcast and Imaging Branch by calling 202/358-1900. The photo number is:

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For Release
June 11, 1993

Peter Waller
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RELEASE: 93-110

PIONEER CELEBRATES 10 YEARS BEYOND THE KNOWN SOLAR PLANETS

The most distant manmade object, Pioneer 10, on Sunday celebrates the 10th anniversary of becoming the first spacecraft to explore beyond the orbit of Pluto, currently the most distant solar system planet discovered.

Pioneer 10 continues to send back science data to Earth even though the spacecraft is 5 1/2 billion miles from its home planet. It takes more than 8 hours for Pioneer 10's radio signal to make the trip to Earth.

Pioneer 10 left all the known planets behind on June 13, 1983. Launched in 1972, the 570-pound spacecraft had a design life of 21 months. More than two decades later, it continues to hurtle through deep space at close to 30,000 miles per hour.

Five of the 11 instruments aboard are still sending back data through the spacecraft's 7 1/2 watt radio signal, about the strength of a home nightlight. Pioneer 10 has transmitted more than 170 billion bits of science data. By the time its signal reaches the football-field-sized antennas of NASA's Deep Space Network, the signal has the strength of 4-billionths of a trillionth of a watt.

During its long life, Pioneer 10 has scored a number of firsts -- the first spacecraft to cross the asteroid belt; to fly by Jupiter and return pictures; to chart Jupiter's intense radiation belts; to measure the mass of its four planet-sized moons; to locate the giant planet's magnetic field and to discover that Jupiter is predominantly a liquid planet.

As it plows through unexplored space, Pioneer 10 continues to seek the boundary between the solar wind and true interstellar space, to search for evidence of a possible 10th planet and for gravity waves confirming Einstein's Theory of Relativity.

- more -

Events such as collisions between entire galaxies would "rattle" the actual structure of space itself, producing gravity waves. The waves may be relatively easy to detect in the long wavelengths (1 billion to 5 billion miles).

"Pioneer 10 and its sister ship, Pioneer 11, have been two of the greatest scientific successes of the Space Age," said Dr. James Van Allen of the University of Iowa, a Pioneer principal investigator.

Perhaps Pioneer 10's most important finding about the outer solar system is the extent of the sun's atmosphere, originally thought to have ended at the orbit of Jupiter or Pluto. Pioneer 10 is now almost 10 times that far and still within the solar atmosphere. Many scientists now say that the solar wind boundary interface with the cosmic interstellar gas might be as far away as 9.3 billion miles, compared to Earth's distance from the sun of 93 million miles.

"Pioneer 10's exploration of the outer heliosphere (sun's atmosphere) and its interface with the interstellar gas is of fundamental scientific importance," said Dr. Frank B. McDonald of the University of Maryland, Principal Investigator for the cosmic ray telescope. "By lasting so long, Pioneer 10 has in essence created a new science mission and represents a triumph for American technology and industry."

"We still take science data from it daily and will probably continue to do so until at least 1998. That's an out-of-this-world record of accomplishment," said Richard Fimmel, Ames' Pioneer 10 Project Manager.

Pioneer 10 is managed by NASA's Ames Research Center, Mountain View, Calif., and was built by TRW, Redondo Beach, Calif.

- end -

News

National Aeronautics and
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Washington, D.C. 20546
AC 202 453-8400

ISY

Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-0883)

Michael Finneran
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-5565)

For Release
June 14, 1993
4:00 p.m. EDT

RELEASE: C93-g

USRA SELECTED TO NEGOTIATE $31 MILLION CONTRACT

NASA has selected the Universities Space Research Association, Columbia, Md., to negotiate a cost-plus-fixed-fee contract for the Visiting Scientists Program at Goddard Space Flight Center, Greenbelt, Md.

The 5-year contract is expected to take effect Sept. 1, 1993, and will provide 355 person-years of support to Goddard's space sciences and earth sciences directorates. The total proposed estimated cost and fee for the 5-year period is $31 million.

The Visiting Scientists Program will provide top-level scientists, both foreign and domestic, the opportunity to conduct independent research in support of NASA programs at Goddard. Research will be conducted for programs including the Compton Gamma-Ray Observatory, the Cosmic Background Explorer, the Hubble Space Telescope, the Earth Observing System and the Sea-Viewing Wide Field Sensor.

- end -

News

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For Release
June 14, 1993
4:00 p.m. EDT

Michael Finneran
Goddard Space Flight Center, Greenbelt, Md.
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RELEASE: C93-h

FAIRCHILD SELECTED TO NEGOTIATE $91 MILLION CONTRACT

Fairchild Space and Defense Corp., Germantown, Md., has been selected by NASA's Goddard Space Flight Center, Greenbelt, Md., for negotiations leading to the award of a cost-plus-award-fee contract.

The 7-year, $91-million contract will provide instrument support services to the Engineering Directorate at Goddard.

The contract will provide on- and off-site engineering and technical support for scientific and application flight instruments, feasibility studies, system definition studies, execution phase flight hardware, research and technology unique to instrument development and related incidental requirements.

- end -

NASA News

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ISY

For Release

Allen Clark
Headquarters, Washington, D.C.
(Phone: 202/358-1826)

June 17, 1993

Statement by Daniel S. Goldin
NASA Administrator
on space station redesign

America took another important step forward on the space frontier today with the decision by President Clinton to continue the space station project. We at NASA are gratified by the faith the President has placed in us to accomplish this challenging task, and inspired by his vision for our country's future in space.

Only a few months ago the President charged NASA with a task many called impossible. But NASA met the challenge. People representing every part of the agency worked long hours and at great personal sacrifice, and in so doing achieved the impossible. I want all Americans to be aware of the extraordinary effort put in by all of NASA'S employees. I could not be prouder of any group of individuals than I am of the NASA team, our country is well served by these men and women

We remain committed to ensuring America's competitiveness in science and technology now and into the 21st Century. And this project will help us meet that need. The space station will be a knowledge engine on the high frontier, returning dividends to Americans for years to come.

But there are larger issues at stake, and we are pleased that the debate over this program is beginning to encompass the landscape we know as the future. In the wake of the Cold War, it is important for this nation to achieve a consensus on future goals for the space program. It is important for us to ask ourselves what kind of a space program we want, what kinds of goals we should pursue, and what kind of legacy we want to hand down to our children.

With the President's leadership and support, I believe we have the opportunity to help define a new era of international peace and cooperation through our scientific partnerships in space. The 20th Century has been one long panorama of war and conflict. Now the world is changing, and with luck and with vision we may be able to replace a century of war with a new century of peace and understanding. Space cannot be left out of that equation, for space encompasses the essential challenges we will face in this new age.

- more -

Over the next few months, as we transition the existing space station program structure to support the redesign option selected by the President, we will pay close attention to NASA's most precious resource -- its people, employees and contractors alike. We will do our utmost to minimize disruption during the process of restructuring the program.

In a larger context, all of us at NASA must rededicate ourselves to continuing the internal improvements we have begun. Together, we have made great strides in the last year. We have begun to fundamentally change NASA for the better. But there is much more to do, and this is the time to do it.

It is an honor that NASA has been asked to participate in Vice President Gore's National Performance Review. We must use this opportunity to set our course and make the space agency a model for effective government research and development.

Only by committing ourselves to these goals can we live up to the faith and trust that President Clinton has placed in us. As responsible stewards for the nation's space program, we can do no less. I look forward to working with the entire NASA family on these exciting goals during the challenging times ahead.

- end -

NASA News

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ISY

For Release

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June 17, 1993

NOTE TO EDITORS: N93-33

NASA TO BRIEF PRESS ON NEW COMMUNICATIONS SATELLITE

NASA and its industry and academic partners will conduct a briefing on the history, technical advances, experiments and benefits of the Advanced Communications Technology Satellite (ACTS) on Wednesday, June 23, at 9:30 a.m. EDT in the NASA Headquarters Auditorium at 300 E St., SW, Washington.

ACTS will be deployed on the STS-51 Space Shuttle mission, set for launch on July 17. ACTS will be placed into a geostationary orbit by a Transfer Orbital Stage following the Shuttle deployment.

The ACTS program brings together new technology from both the communications satellite and ground station perspectives–including the first commercial use of the Ka-band and onboard "smart" communications processors which will allow for single-uplink and multiple downlink capabilities. More than 70 investigations are scheduled for the satellite's first 2 years.

The briefing will be divided into two sessions with the first focusing on the program history, specific technologies, industry participation and probable impact on the overall future of telecommunications.

The second panel will begin at 10:45 a.m. and will address specific experiment objectives and how these benefit American economic and technical competitiveness.

Briefers from both panel sessions will be available for one-on-one interviews following the presentation.

This briefing will not be carried on NASA Select television due to live coverage of the STS-57 Space Shuttle mission.

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For Release

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Headquarters, Washington, D.C.
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June 18, 1993

NOTE TO EDITORS: N93-34

NASA TO ENCOURAGE USE OF SMALL DISADVANTAGED BUSINESSES

NASA has made available a 21-minute videotape and brochure, "Successful Subcontracting with SDB's." The video is part of an effort by NASA to encourage the use of Small Disadvantaged Businesses (SDB) by NASA's prime contractors.

"Successful Subcontracting with SDB's" features four examples of effective teamwork between prime contractors and SDB subcontractors, including the pairing of a prime contractor (General Dynamics) and a Historically Black University (Tuskegee University in Alabama).

The video is designed to help contractor CEO's, executives, managers and buyers to enhance their SDB subcontracting performance. With this initiative, NASA seeks to build on its fiscal 1992 SDB subcontracting awards of $865 million by prime contractors and approach $900 million for fiscal 1993.

"As Administrator of NASA, I have made a personal commitment to increasing cultural diversity in the workplace and to increasing the contracting opportunities for small and disadvantaged contractors," NASA Administrator Daniel S. Goldin said.

"Successful Subcontracting with SDB's" was produced by Morris Communications International Inc., a SDB located in Des Moines, Iowa. Copies of the videotape and brochure may be obtained by contacting the NASA Headquarters Newsroom, Code PM, NASA Headquarters, Washington, D.C., 20546, or by phone at 202/358-1600.

- end -

NASA News

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For Release

Michael Braukus
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

June 21, 1993

Gail Blatt
NIDCD, Bethesda, Md.
(Phone: 301/496-7243)

RELEASE: 93-111

NASA AND NIDCD SELECT VESTIBULAR RESEARCH CENTER

NASA and the National Institute on Deafness and Other Communication Disorders (NIDCD) jointly selected a proposal from a consortium of institutions to place the Center for Vestibular Research at Northwestern University, Evanston, Ill.

"This new research center will not only help those who may experience space motion sickness as they live and work in space, but also will have the potential of improving the quality of life for some of the more than 90 million Americans who have experienced either dizziness or a balance problem," said NASA Administrator Daniel S. Goldin.

The center is designed to define the contributions of the vestibular system to the control of balance, posture and locomotion through ground-based and space-based studies. One of the center's goals is to produce a complete whole body model of posture, something never before attempted.

The center also will focus upon the vestibular otolith organs (small vestibular organs in the inner ear) and sensory motor responses which are of special importance for understanding how these organs react to changes in gravity.

The major goal of this collaboration is to enhance basic knowledge and understanding of vestibular functioning by providing investigators with greater access to NASA's unique ground-based research facilities and to space flight. The center will receive $1 million per year for 5-years. This funding will be shared equally by both agencies.

In addition to Northwestern University, the consortium includes the University of Chicago, the Rehabilitation Institute of Chicago, the Oregon Health Sciences University and the Good Samaritan Hospital, both of Portland, Oregon.

- more -

Dr. Barry W. Peterson, Northwestern University, has been named the Program Director. Dr. Fay B. Horak of the Dow Neuroscience Institute of the Good Samaritan Hospital is the Co-director.

The selection is a result of an agreement signed by NASA and NIDCD last year to expand biomedical cooperation between the two agencies.

- end -

NASA News

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Barbara Schwartz
Johnson Space Center, Houston
(Phone: 713/483-5111)

For Release

June 15, 1993

RELEASE: 93-113

ASTRONAUT BLUFORD LEAVES NASA

Col. Guion S. Bluford, Jr., will leave NASA in July and retire from the U.S. Air Force to join NYMA, Inc., Greenbelt, Md., as Vice President and General Manager of the Engineering Services Division. NYMA provides engineering and software support services to the Federal Aviation Administration, the Justice Department, the Department of Defense and to NASA.

Bluford was among the first group of Shuttle-era astronauts selected in 1978. He has served as a mission specialist astronaut on 4 Space Shuttle flights, making history as the first African-American astronaut aboard STS-8 in August 1983. He also flew on STS-61A, the first German D-1 Spacelab mission in October 1985, and two Department of Defense scientific research missions, STS-39 in April 1991 and STS-53 in December 1992. Bluford has logged over 688 hours in space.

"I feel very honored to have served as a NASA astronaut and to have contributed to the success of the Space Shuttle program. I will miss working with the people at JSC and the team spirit and esprit de corps that comes with flying crew members in space," Bluford said.

In addition to his flight assignments, Bluford has held numerous technical assignments at Johnson Space Center, Houston, including working Space Station Freedom operations, the Remote Manipulator System, Spacelab systems and experiments, Space Shuttle systems, payload safety issues, and verifying flight software in the Shuttle Avionics Integration Laboratory and in the Flight Systems Laboratory.

"Guy will be missed, but he leaves a legacy that is important to NASA and to the nation. There are many young people today who have been inspired to pursue careers in science and engineering because of his achievements," Director of Flight Crew Operations David. C. Leestma said.

- end -

NASA News

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Headquarters, Washington, D.C.
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Donald Nolan
Dryden Flight Research Facility, Edwards, Calif.
(Phone: 805/258-3447)

For Release
June 16, 1993

RELEASE: 93-115

NASA F-15 BEING READIED FOR ADVANCED MANEUVERING FLIGHT

A specially-modified NASA F-15 research aircraft, which could substantially advance the cruising efficiency and flight maneuverability of future U.S. aircraft, arrived yesterday at the agency's Ames-Dryden Flight Research Facility, Edwards, Calif.

This research program could substantially advance the cruising capability and flight maneuverability of future aircraft.

The research program will test how advanced thrust vectoring engine nozzle technology can improve the aircraft's performance during cruising flight or in maneuvering. NASA will use the new F-15 in the Advanced Control Technology For Integrated Vehicles, ACTIVE, program.

"When we add the advanced multi-axis thrust vectoring engine nozzles and advanced aircraft computing and control systems, this F-15 will be an exceptional flight research facility," said Dr. James Stewart, Project Manager.

Developed by Pratt & Whitney Government Engines and Space Division, West Palm Beach, Fla., the new thrust vectoring system will fly for the first time on the NASA F-15. The nozzles, much lighter than previous exhaust vectoring systems, could be retrofitted to existing aircraft or used in future aircraft designs.

NASA will use the modified F-15 to expand digital-integrated flight and propulsion control system studies. This research will be complex because these F-15 systems now must control canards (small wings) on the plane's forward fuselage and a set of innovative engine exhaust-directing nozzles.

- more -

The F-15 has an advanced electronic cockpit, fully digital flight controls, an extensive computer system and originally, was built to carry the load of a vectoring system.

The nozzles can direct the F-15's engine exhaust in a full circle up to a 20-degree angle. This will permit researchers to study maneuvering qualities using the nozzles for pitch (up and down) and yaw (side to side) control.

Dryden will install two F-100-229 Pratt & Whitney engines, the vectoring nozzles and an advanced Vehicle Management System computer to modify the aircraft to the ACTIVE program configuration.

The first phase of the program is expected to start in late 1993. It is a joint effort of NASA, the Air Force, Pratt & Whitney and McDonnell Douglas, St. Louis, Mo.

The F-15, on loan from the U.S. Air Force, was flown to Dryden from the McDonnell Douglas plant in St. Louis by NASA research pilot Jim Smolka and McDonnell Douglas pilot Stephen Herlt.

The U.S. Air Force used the F-15 from 1985 to 1991 in a test program to prove technologies for short take off and landing and "up-and-away" maneuvering of military aircraft.

-end-

NOTE TO EDITORS: Video and stills of the F-15's arrival are available from the Dryden media relations office, 805/258-3447.

NASA News

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Terri Sindelar
Headquarters, Washington, D.C.
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For Release

June 18, 1993

RELEASE: 93-116

MINORITY STUDENTS APPRENTICE ON SPACE RESEARCH

NASA today announced the selection of 100 minority high school students to participate in a new NASA education program called SHARP PLUS Research Apprenticeship Program.

SHARP PLUS is a collaborative effort between NASA, Historically Black Colleges and Universities and aerospace and other industries to increase the opportunities and experiences for minority students interested in careers in mathematics, science and engineering by offering research apprenticeships.

The ultimate goal of SHARP PLUS is to help increase the number of minorities in the science and engineering professions by providing students hands-on opportunities to enhance their college education and career choices.

Beginning June 21, students will participate in an 8-week, research-based, mentor program being held at five predominantly minority universities located near NASA field centers.

The students were selected from over 600 applicants based on their aptitude and interest in science and engineering. During the 8-week program, students will live on campus and spend about 80 percent of their experience working with researchers on cutting-edge research projects performed at nearby industrial sites or in the universities' research laboratories. Students will earn a salary for their time spent as apprentices.

The following universities will host 20 SHARP PLUS apprentices this summer:

Alabama A&M University, Normal
Florida A&M University, Tallahassee
Hampton University, Hampton, Va.
Morgan State University, Baltimore, Md.
Texas Southern University, Houston

- more -

Each student will be placed with mentors based on the student's areas of interest and their skill levels. Assignments will be selected affording students the best opportunity to apply their knowledge and skills and to contribute to the research project.

Twenty percent of each student's experience will be spent in campus-related activities such as lectures, tours, career counseling and interacting with current technical professionals. Each student, as well as their mentor, will prepare written reports about their individual activities, what they have learned and their progress in the program.

Throughout the apprenticeship, each student will have careful work-site and residential supervision and guidance by a SHARP PLUS faculty coordinator at each university.

For consideration in the program, students must be at least 16 years of age, enrolled in high school and have completed the 10th grade. The courses required include algebra, geometry and at least 1 year of biology, chemistry or physics with a grade of B or better. Students also must demonstrate an interest in pursuing a science or engineering career.

The Quality Education for Minorities (QEM) network, a non-profit organization dedicated to improving the education of minorities throughout the nation, serves as NASA's facilitator for the new education program.

- end -

Editors Note: For additional information on the SHARP PLUS program and the students selected, contact Laura-Lee Davidson or M.J. Fingland at QEM on 202/659-1818.

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600

Michael Braukus
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release

June 21, 1993

RELEASE: 93-117

STUDENTS BEGIN NASA LIFE SCIENCES TRAINING PROGRAM

Forty college students today started an intensive 6-week Space Life Sciences Training Program (SLSTP) at NASA's Kennedy Space Center, Fla. The summer residence training program is for college students interested in life sciences, bioengineering, ecology or related fields.

The SLSTP is designed to attract college students towards a career in space life sciences research. Selected students work with NASA researchers in planning flight and ground support experiments. In addition to offering research experience, the curriculum includes lectures, tours and special projects to provide a complete overview of the field of space life sciences.

The special project areas this year will involve plant space biology, global environment and monitoring of microbes in the shuttle crew water system. The program will be held from June 21 through July 31, 1993.

The 40 students were competitively selected from 348 applicants. Students in the program must be undergraduates majoring in science or engineering and have a minimum cumulative grade point average of 3.0. More than 288 students have participated in the program since its inception in 1985.

The students participating in the program are:

Cheryl L. Baird, Wharton, N.J.
Richard D. Boyce, Yakima, Wash.
Robbin N. Chapman, Brooklyn, N.Y.
Danielle M. Cox, Norfolk, Va.
Antonette L. Diaz, Colstrip, Mont.
Kathryn A. Drabik, Albuquerque, N.M.
Diane S. Eschliman, Lincoln, Neb.
Anton A. Ewing, Prescott, Ariz.
Monica V. Florez, Royal Palm Beach, Fla.

- more -

Keven G. Haggerty, Bourbonnais, Ill.
Barbara L. Hammack, Santee, Calif.
Brian D. Hartman, College Place, Wash.
Gerardo A. Hernandez, Caguas, Puerto Rico
Erica Y. Hwang, Allston, Mass.
Frank P. Johnson, Titusville, Pa.
Reshma C. Katira, E. Emherst, N.Y.
Christine A. Krumrich, Wales, Wis.
Anna Pei-Ching Lee, Cary, N.C.
Tracy L. Lewis, Dixmoor, Ill.
Susan W. Mao, Monument, Colo.
Janean E. Martin, East Windsor, N.J.
James L. McBride, Jr., Houston, Texas
Quinton E. Moss, Chesapeake, Va.
Kymberli A. Mumford, Jacksonville, Fla.
Lemuel H. Newton, Tallahassee, Fla.
Lisa J. Passmore, Widefield, Colo.
Tamula M. Patterson, Hueytown, Ala.
Enrique Pomales-Crespo, Hormigueros, Puerto Rico
Kristine Reynolds-Sohnrey, Eugene, Ore.
Meghan V. Roxby, Old Town, Maine
Lisa A. Scheppers, Gering, Neb.
Mark E. Schneider, Kokomo, Ind.
Kathryn L. Sellen, Moore, Okla.
Gregory B. Singer, Brighton, Mass.
Brianna M. Smith, Bellwood, Ill.
Marc O. Spangner, Vacaville, Calif.
Kelly M. VanBuskirk, Middletown, R.I.
David A. Van De Car, Altamonte Springs, Fla.
Brenda A. Westhoff, Manhattan, Kan.
David H. Zonies, Philadelphia, Pa.

- end -

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For Release

Brian Dunbar
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June 22, 1993

Allen Kenitzer
Goddard Space Flight Center, Greenbelt, Md.
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NOTE TO EDITORS: N93-35

DEFORESTATION STUDIES BRIEFING SCHEDULED

NASA will conduct a press briefing at 1 p.m EDT, June 24, to discuss new refined estimates of the extent of tropical deforestation and forest fragmentation in the Brazilian Amazon Basin.

The briefing will be held in the NASA Headquarters auditorium, 300 E Street, S.W. ,Washington, D.C.

Presenting the analysis of Landsat-4 and -5 data will be Dr. Compton J. Tucker of NASA's Goddard Space Flight Center, Greenbelt, Md. **Information presented in this briefing is strictly embargoed until 6 p.m. EDT, June 24.**

Color images illustrating the results will be available to the media through NASA's Broadcast and Imaging Branch, 202/358-1900, on Thursday, June 22.

Because of ongoing coverage of the STS-57 Space Shuttle mission, this briefing will not be carried on NASA Select. It will be videotaped and may be replayed at a later date.

- end -

NASA News

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For Release

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June 23, 1993

Jim Doyle
Jet Propulsion Laboratory, Pasadena, Calif.
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RELEASE: 93-118

SHUTTLE OZONE DATA RETRIEVED FROM ATMOS RECORDER

Important ozone data was saved by a new tape recorder during an April Space Shuttle mission.

Despite transmitting problems, the on-board data recovery system captured 103 orbital sunrises and sunsets observed by the Atmospheric Trace Molecule Spectroscopy (ATMOS) instrument. ATMOS, part of the second Atmospheric Laboratory for Applications and Science (ATLAS 2), measures up to 40 gases that affect global ozone levels. The ATLAS 2 mission's orbital path allowed ATMOS to measure the gases over high northern latitudes during the early spring, when the atmosphere is changing from winter to summer circulation patterns. These circulation patterns affect the weather conditions that can lead to ozone depletion.

The ATLAS series, which began in 1992, is part of NASA's Mission to Planet Earth, which uses the unique global perspective available from space to study how the environment changes. The ATLAS instruments observe the chemical makeup of the atmosphere and the energy output of the Sun, two of the key factors in the creation and depletion of ozone.

ATMOS has flown aboard the Shuttle two other times but the April flight, designated STS-56, was an engineering test flight for the ATMOS recorder subsystem.

- more -

During the flight, the Shuttle's telemetry system, which would have transmitted ATMOS data to the ground during flight, ran into problems. ATMOS/Spacelab controllers and the Space Shuttle flight team developed a plan that allowed the Spacelab's high data rate recorder to record some data on the orbiter data system and transmit it at a reduced rate. Unfortunately the data included some errors, project officials said, rendering most of this data useless.

The ATMOS team was able to rely on its recorder subsystem, a separate, dedicated data recording system that uses a tape recorder manufactured by Schlumberger Industries, a French company. The recorder saved the atmospheric observations, said ATMOS Assistant Project Manager Greg Goodson. In early June, the data tape was played back for the first time at NASA's Jet Propulsion Laboratory, Pasadena, Calif.; scientists found the data's quality to be excellent.

The new recorder subsystem, which has a 44-gigabyte (353 billion bits) storage capacity, recorded more than half of the scheduled ATMOS observations -- nearly 6-1/2 hours of data. Results of the data analysis, which is already underway, are expected to be published within the next year, Goodson said. The results will present a better understanding of the gases that damage the ozone layer.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600

Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release
EMBARGOED UNTIL
June 24, 1993 6:00 P.M. EDT

Allen Kenitzer
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-8955)

RELEASE: 93-119

NASA STUDY REFINES ESTIMATES OF AMAZON DEFORESTATION

Tropical deforestation and adverse effects on tropical forest habitat have increased in the Brazilian Amazon Basin since the late 1970s, a University of New Hampshire-NASA study has revealed.

Data from the Landsat-4 and -5 satellites covering 1978-88 indicate that although the extent of deforestation is less than expected, deforestation has increased substantially and created adverse "edge effects" that pose a substantial threat to the habitat of plant and animal species.

The study indicates that between 1978 and 1988, the rate of deforestation in the Brazilian Amazon Basin was 6,000 square miles (15,000 square kilometers) per year. Results of the study, conducted at NASA's Goddard Space Flight Center, Greenbelt, Md., and the University of New Hampshire, Durham, will be published in the June 25 issue of Science magazine.

"We are seeing less deforestation than had been expected," said David Skole, Ph.D., a research assistant professor with the Institute for the Study of Earth, Oceans and Space at the University of New Hampshire. Dr. Skole is the lead author of the Science paper. "Our study helps clarify actual greenhouse gas emissions, such as carbon dioxide, resulting from tropical deforestation."

"Although we found lower deforestation than previously estimated, the effect upon biological diversity is greater," said Compton Tucker, Ph.D., a research scientist in the Laboratory for Terrestrial Physics at the Goddard Center. Dr. Tucker was co-author on the paper.

-more-

Skole and Tucker studied more than 200 Landsat satellite images, covering the entire forested portion of the Brazilian Amazon Basin. Using Landsat images and a computerized geographic information system, they made specific measurements of deforestation, fragmented forest and edge effects. A fragmented forest is forest surrounded by deforested area. "Edge effects" are the destruction or degradation of natural habitat that occur on the fringes of fragmented forests. These effects include greater exposure to wind, weather, foraging livestock, other non-forest animals and humans.

Tropical deforestation increases atmospheric carbon dioxide and has profound implications for biological diversity through destruction of habitat. The conversion of forests to cropland and pasture increases atmospheric carbon dioxide because the carbon content of the forests is higher than that of the agricultural crops that replace them.

Carbon dioxide and several other gases in the atmosphere trap heat radiating from the Earth's surface toward space. In doing so, they act similarly to the glass in a greenhouse, which also traps heat, creating the "greenhouse effect."

NASA funded the research as part of its Mission to Planet Earth, a long-term program that is studying how the global environment is changing. Using the unique perspective available from space, NASA is observing large-scale environmental processes, such as the role of forests in climate change.

The goal of Mission to Planet Earth is to allow humans to better understand natural environmental changes and to distinguish natural changes from human-induced changes, such as deforestation caused by expanding agriculture. Mission to Planet Earth data, which NASA will distribute to researchers worldwide, is essential to humans making informed decisions about protecting their environment.

The GSFC-University of New Hampshire study typifies NASA's efforts to work with researchers outside the agency to reduce uncertainty about important environmental issues. These ground-based analyses of satellite data will help quantify environmental changes and clarify the interaction of large environmental systems, such as the tropical forest and climate.

While occupying less than 7 percent of the Earth's surface, tropical forests are home to more than half of all plant and animal species. Deforestation is leading to massive extinction of species, including Q for the first time Q large numbers of vascular plant species, such as trees.

"The primary cause of Brazilian deforestation in the last two decades can be attributed primarily to agricultural expansion," Tucker said.

The Brazilian Amazon is the largest contiguous tropical forest region in the world. Worldwide estimates of tropical deforestation range from 27,000 square miles (69,000 square kilometers) per year in 1980 to 64,000 square miles (165,000 square kilometers) in the late 1980s.

The Amazon Basin of Brazil includes all or part of 8 Brazilian states, covering 2 million square miles (5 million square kilometers). In that region, 1.6 million square miles (4 million square kilometers) are forested, 330,000 square miles (850,000 square kilometers) are tropical savanna and 35,000 square miles (90,000 square kilometers) are water.

By using satellite data and the geographic information system, scientists can explicitly map, or stratify, different categories of the Earth's geographic features, such as forests and grasslands, providing a means to compare deforestation results from other studies.

As the second generation of American remote sensing satellites, Landsat-4 was launched July 16, 1982 and Landsat-5 was launched on March 1, 1984; both from Vandenberg Air Force Base, Calif., on Delta rockets.

- end -

News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400

ISY

For Release

Mark Hess
Headquarters, Washington D.C.
(Phone : 202/358-1778)

June 24, 1993
1:00 pm EDT

RELEASE: 93-120

TWO ASTRONAUTS APPOINTED TO HEADQUARTERS POSITIONS

NASA Administrator Daniel S. Goldin today announced the appointment of two astronauts to senior management positions at NASA Headquarters, Washington, D.C.

Appointed are William M. Shepherd and James D. Wetherbee as Assistant Deputy Administrators - Technical. They will assist the Administrator and the Acting Deputy Administrator in providing technical oversight of NASA's programs.

In addition to serving in this capacity, they have been designated as acting leaders of the transition activities for the Redesign Space Station program under the direction of Bryan O'Connor, the Director, Space Station Redesign.

Shepherd, a 1971 Naval Academy graduate, received the degrees of ocean engineer and master of science in mechanical engineering from the Massachusetts Institute of Technology in 1978. He is a veteran of 3 Space Shuttle missions, STS-27 in December 1988, STS-41 in October 1990 and STS-52 in November 1992.

Wetherbee is a graduate of the University of Notre Dame and a 1974 graduate of the U.S. Naval Test Pilot School. He served as the project officer and test pilot for the weapons delivery systems and avionics integration for the F/A-18 aircraft. He is a veteran of 2 Space Shuttle missions, serving as a pilot on STS-32 in January 1990 and as commander of STS-52 in November 1992.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400

ISY

Drucella Andersen
Headquarters, Washington, D.C.
(Phone: 202/358-4733)

For Release

June 25, 1993

EDITORS NOTE: N93-36

NATIONAL AERO-SPACE PLANE TECH TRANSFER EXHIBIT AT NASA

Media representatives are invited to view an exhibit of technology transfer "success stories" involving the National Aero-Space Plane (NASP) program on Monday, June 28.

The exhibit will be open from 11 a.m. until 4 p.m. EDT in the west lobby of the NASA Headquarters building at 300 E Street, S.W., Washington, D.C. NASP officials will be on hand to discuss technology transfer results that benefit a wide range of American business, including the aircraft, automotive and medical industries.

- end -

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

93-121

SPACE SHUTTLE MISSION

STS-51

PRESS KIT

JULY 1993

ACTS/ORFEUS-SPAS

Advanced Communications Technology Satellite
Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer- Shuttle Pallet Satellite

PUBLIC AFFAIRS CONTACTS

For Information on the Space Shuttle

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Nancy Lovato Dryden Flight Research Facility, Edwards, Calif.	DFRF Landing Information	805/258-3448

For Information on NASA-Sponsored STS-51 Experiments

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Charles Redmond Headquarters, Wash., D.C.	ACTS experiments	202/358-1757

CONTENTS

RELEASE: 93-121

ACTS DEPLOYMENT HIGHLIGHTS STS-51 MISSION

The deployment of a satellite which will serve as a testbed for technology leading to a new generation of communication satellites and the deployment and retrieval of a U.S./German free-flying scientific observation satellite highlight NASA's Shuttle Mission STS-51.

The mission, which is scheduled for mid-July, 1993, also will see Space Shuttle Discovery and her five-person crew conduct a variety of experiments on the effects of microgravity on various plants and materials along with other payloads which will perform photographic observations during the mission.

The Advanced Communications Technology Satellite (ACTS) program provides for the development and flight test of high-risk, advanced communications satellite technology. Using sophisticated antenna beams and advanced on-board switching and processing systems, ACTS will pioneer new initiatives in communications satellite technology.

The Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer - Shuttle Pallet Satellite (ORFEUS-SPAS) mission is the first of a series of missions using the German built ASTRO-SPAS science satellite. ASTRO-SPAS is a spacecraft designed for launch, deployment and retrieval by the Space Shuttle.

Once deployed from the Shuttle by its Remote Manipulation System (RMS), ASTRO-SPAS operates quasi-autonomously for several days in the Shuttle vicinity. After completion of the free flight phase, the satellite is retrieved by the RMS and returned to Earth. ORFEUS-SPAS is an astrophysics mission, designed to investigate very hot and very cold matter in the universe.

On the fifth day of the mission, two STS-51 crew members will perform a 6-hour extravehicular activity (EVA), or spacewalk, as part of a continuing series of test spacewalks NASA is conducting to increase experience with spacewalks and refine spacewalk training methods.

In addition to performing tasks that investigate a spacewalker's mobility in general, the astronauts will evaluate several tools that may be used during the servicing of the Hubble Space Telescope (HST) later this year on mission STS-61, including a power socket wrench, a torque wrench, foot restraint, safety tethers and tool holder.

- more -

Leading the STS-51 crew will be Mission Commander Frank Culbertson who will be making his second space flight. The pilot for the mission is William Readdy, making his second flight. The three mission specialists for this flight are Daniel Bursch (MS-1), James Newman (MS-2) and Carl Walz (MS-3), all three of whom will be making their first flight.

The mission duration for STS-51 is planned for 9 days with a scheduled landing at the Kennedy Space Center, Fla.

This will be the 17th flight of Space Shuttle Discovery and the 57th flight of the Space Shuttle system.

(end general release - background information follows)

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is available on Satcom F-2R, Transponder 13, located at 72 degrees west longitude; frequency 3960.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla.; Marshall Space Flight Center, Huntsville, Ala.; Ames-Dryden Flight Research Facility, Edwards, Calif.; Johnson Space Center, Houston and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule is updated daily at noon Eastern time.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a Flight Director or Mission Operations representative and when appropriate, representatives from the science team, will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-51 QUICK-LOOK

Launch Date/Site:	July 1993, Kennedy Space Center - Pad 39B
Launch Time:	TBD
Orbiter:	Discovery (OV-103) - 17th Flight
Orbit/Inclination:	160 nautical miles/28.45 degrees
Mission Duration:	8 days, 21 hours, 59 minutes
Landing Time/Date:	TBD
Primary Landing Site:	Kennedy Space Center, Fla.
Abort Landing Sites:	Return to Launch Site - KSC, Fla. Transatlantic Abort landing: Banjul, The Gambia; Ben Guerir, Morocco; Moron, Spain Abort Once Around: Edwards AFB, Calif.
Crew:	Frank Culbertson, Commander (CDR) William Readdy, Pilot (PLT) Jim Newman, Mission Specialist 1 (MS1) Dan Bursch, Mission Specialist 2 (MS2) Carl Walz, Mission Specialist 3 (MS3)

Cargo Bay Payloads & Activities

Advanced Communication Technology Satellite/Transfer Orbit Stage (ACTS/TOS)
Orbiting Retrievable Far and Extreme Ultraviolet Spectrometer - Shuttle Pallet Satellite (ORFEUS-SPAS)
Limited Duration Space Environment Candidate Materials Exposure (LDCE)

In-Cabin Payloads

Air Force Maui Optical Site (AMOS)
Auroral Photography Experiment-B (APE-B)
Commercial Protein Crystal Growth (CPCG)
Chromosome and Plant Cell Division in Space (CHROMEX)
High Resolution Shuttle Glow Spectroscopy-A (HRSGS-A)
IMAX
Investigations into Polymer Membrane Processing (IPMP)
Radiation Monitoring Equipment-III (RME-III)

STS- 51 PAYLOAD AND VEHICLE WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Discovery) empty and 3 SSMEs	173,117
Advanced Communications Satellite/Transfer Orbit Stage	26,756
ACTS Support Equipment	6,394
ORFEUS/SPAS	7,070
LDCE/GAS can	770
APE	41
CHROMEX	69
CPCG	70
HRSGS	91
IMAX Camera System	320
IPMP	20
RME	7
DSOs/DTOs	162
Total Vehicle at SRB Ignition	4,525,219
Orbiter Landing Weight	203,639

STS-51 SUMMARY TIMELINE

Flight Day One
Ascent
OMS-2 (160 n.m. x 161 n.m.)
Remote Manipulator System checkout
CHROMEX check
CPCG activation
RME activation
ACTS/TOS deploy
RCS, OMS Separation burns
(161 n.m. x 173 n.m.)

Flight Day Two
OMS, RCS burns (158 n.m. x 159 n.m.)
ORFEUS/SPAS checkout
ORFEUS/SPAS release
RCS Separation burns (158 n.m. x 159 n.m.)
CHROMEX check
Cabin depress to 10.2 psi

Flight Day Three
Stationkeeping burns (158 n.m. x 159 n.m.)
IPMP activation
CHROMEX check

Flight Day Four
EMU checkout
Stationkeeping burns (158 n.m. x 159 n.m.)
RME check

Flight Day Five
Extravehicular activity preparations
Extravehicular activity (six hours)
Stationkeeping burns (158 n.m. x 159 n.m.)
CHROMEX check

Flight Day Six
Stationkeeping burns (158 n.m. x 159 n.m.)
APE setup
HRSGS setup
CHROMEX check
LDCE operations

Flight Day Seven
Stationkeeping burns
(158 n.m. x 159 n.m.)
LDCE operations
APE operations
HRSGS operations
HRSGS stow
CHROMEX check
RME check

Flight Day Eight
ORFEUS/SPAS rendezvous
ORFEUS/SPAS berth
CHROMEX check
DTO 412: Fuel Cell shutdown

Flight Day Nine
Cabin repress to 14.7 psi
Flight Control Systems checkout
Reaction Control System hot-fire
AMOS
CHROMEX check
Cabin stow
DTO 412: Fuel Cell restart

Flight Day Ten
Deorbit preparations
Deorbit burn
Entry
Landing

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes include:

* **Abort-To-Orbit** (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

* **Abort-Once-Around** (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at Edwards Air Force Base, Calif.

* **Transatlantic Abort Landing** (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Banjul, The Gambia; Ben Guerir, Morocco; or Moron, Spain.

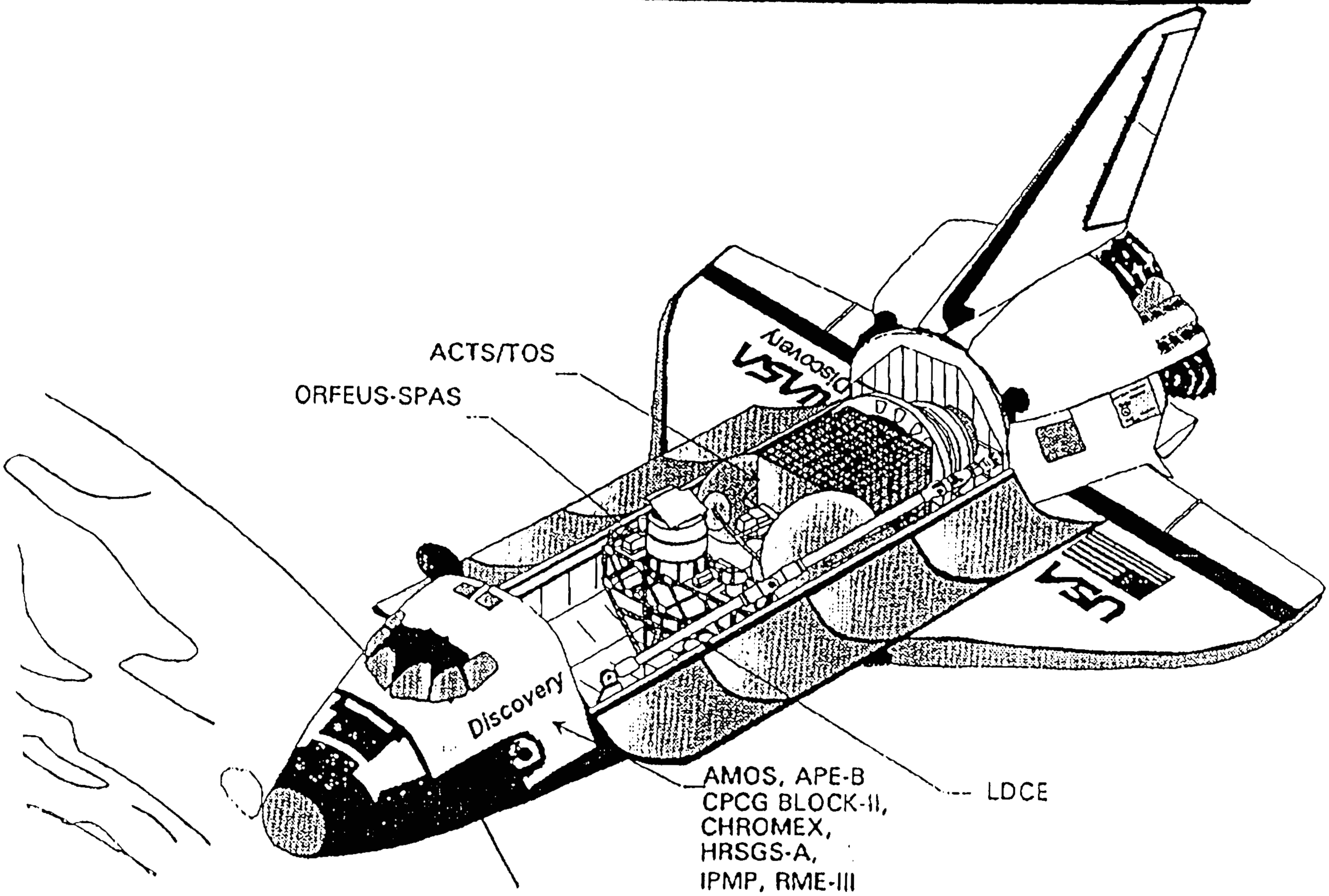
* **Return-To-Launch-Site** (RTLS) -- Early shutdown of one or more engines, and without enough energy to reach Banjul, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-51 contingency landing sites are the Kennedy Space Center, Edwards Air Force Base, Banjul, Ben Guerir and Moron.

STS-51 CREW RESPONSIBILITIES

TASK/PAYLOAD	PRIMARY	BACKUP
ACTS/TOS	Walz	Bursch
ORFEUS/SPAS	Newman	Newman
Middeck experiments:		
APE	Walz	Newman
CHROMEX	Newman	Readdy
CPCG	Bursch	Culbertson
IMAX	Readdy	Walz
IPMP	Newman	Bursch
HRSGS	Newman	Walz
AMOS	Readdy	Bursch
RME	Walz	
DTO's/DSO's:		
EVA	Walz (EV1)	Newman (EV2), Readdy (IV)
ET Photo	Walz	Newman
Fuel Cell	Readdy	Culbertson
PGSC	Newman	Walz
Thermal Print (TIPS)	Newman	Walz
ALBRT	Culbertson	Bursch
Laser Range (hand)	Readdy	Bursch
Laser Range (cargo bay)	Bursch	Readdy
GPS	Walz	Newman
PCMMU	Newman	Walz
VRCS	Readdy	Newman
Exercise	Culbertson	All
Entry ortho tolerance	Newman	Walz
Visual vestibular	Newman	
Posture	Readdy	Walz
Skeletal/muscle	Readdy	All
Gastro function	Bursch	Newman
Blood IV	Readdy	Bursch
ENH stand	Culbertson	Newman, Walz
Other Responsibilities:		
Photography/TV	Readdy	Walz, Culbertson
Earth observations	Readdy	Culbertson
In-flight Maintenance	Walz	Readdy
Medic	Readdy	Bursch

NASA Space Shuttle Program STS-51 Cargo Configuration



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ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS) HARDWARE

The Advanced Communications Technology Satellite (ACTS) provides for the development and flight test of high-risk, advanced communications satellite technology. Using advanced antenna beams and advanced on-board switching and processing systems, ACTS will pioneer new initiatives in communications satellite technology.

ACTS provides new communications satellite technology for:

* Operating in the Ka-band (30/20 GHz) where there is 2.5 GHz of spectrum available (five times that available at lower frequency bands)

* Very high-gain, multiple hopping beam antenna systems which permit smaller aperture Earth stations

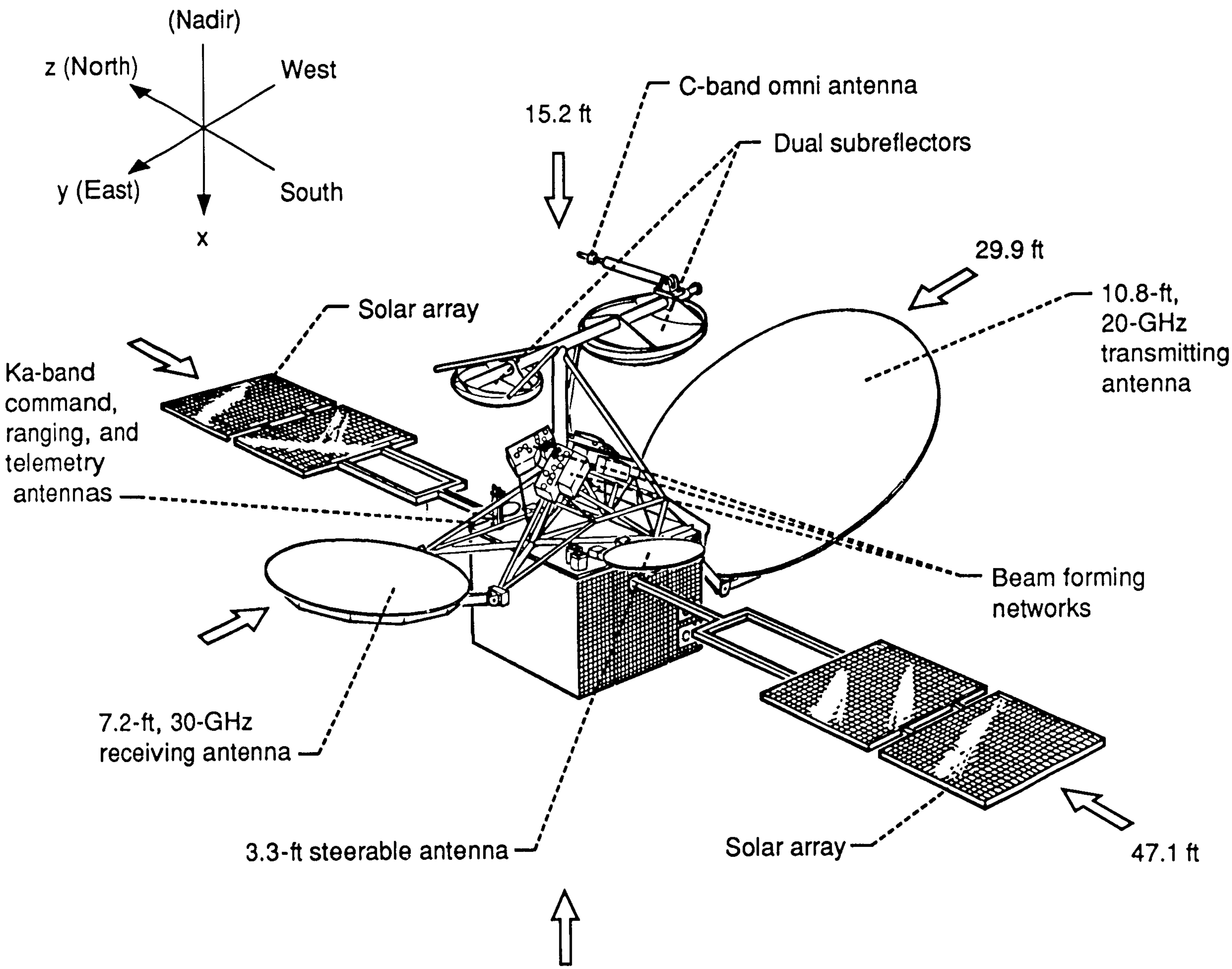
* On-board baseband switching which permits interconnectivity between users at an individual circuit level

* A microwave switch matrix which enables gigabit per second communication between users.

These technologies provide for up to three times the communications capacity for the same weight as today's satellites (more cost effective), much higher rate communications between users (20 times that offered by conventional satellites), greater networking flexibility and on-demand digital services not currently available from communications systems today. The development and flight validation of this advanced space communications technology by NASA's ACTS will allow industry to adapt this technology to their individual commercial requirements at minimal risk. It also will aid the U.S. industry in competing with European and Asian companies which have, in the last decade, developed significant capabilities for producing communications satellites and associated ground equipment.

ACTS technologies, which are applicable for a variety of frequency bands, will potentially lower the cost or technical threshold so that such new services as remote medical image diagnostics, global personal communications, real-time TV transmissions to airliners, direct transmission of reconnaissance image data to battlefield commanders and interconnection of supercomputers will be feasible. Technology spin-off is already occurring.

Motorola currently is adapting the ACTS Ka-band and on-board switching technologies for their $3 billion Iridium satellite system, which will provide global voice/data communications services. Norris Communications also is proceeding with a Ka spot-beam communications satellite.



Spacecraft on-orbit configuration showing overall dimensions.

ACTS Overall Description

ACTS is comprised of a spacecraft bus with basic housekeeping functions and a payload, known as the multibeam communications package (MCP).

At launch, ACTS weighs 6,108 pounds including the propellants and the spacecraft adapter and clamp band which remain with the Transfer Orbit Stage (TOS) upon separation. When in the stowed configuration in the Shuttle payload bay, ACTS' overall height is 15.9 feet (5 m) from the spacecraft separation plane to the tip of the highest antenna.

During the transfer orbit phase, the spacecraft is spin stabilized, and the antenna reflectors and solar array panels are retracted and stowed to provide better load support for these appendages. During the on-orbit mission phase, the spacecraft is three-axis stabilized with the large antenna reflectors facing the Earth and the solar array panels rotating once per day to track the Sun. On-orbit, ACTS measures 47.1 feet (14 m) from tip to tip of the solar arrays and 29.9 feet (9 m) across the main receiving and transmitting antenna reflectors.

Spacecraft Bus

The spacecraft bus structure is a rectangular box with a cylindrical center structure that houses the apogee kick motor (AKM). The multibeam antenna subsystem is mounted to the Earth facing panel of the spacecraft bus. The North and South sides are each divided into three panels. These panels are used to mount most of the spacecraft bus and MCP electronics equipment. The spacecraft bus provides support functions for the MCP such as electrical and mechanical mounting surfaces, attitude control, electrical power, thermal control, command reception, telemetry transmission and ranging and propulsion for station keeping maneuvers.

Multibeam Communications Package

The multibeam communications package performs receiving, switching, momentary storage, selectable coding and decoding, amplifying and transmitting functions for Ka-band time division multiple access (TDMA) communications signals. The multibeam antenna (MBA) has fixed beams and hopping spot beams that can be used to service traffic needs on a dynamic basis. (A hopping spot beam is an antenna beam on the spacecraft that points at one location on the ground for a fraction of a millisecond. It sends/receives voice or data information and then the beam electronically "hops" to a second location, then a third and so on. At the beginning of the second millisecond the beam again points at the first location.)

In addition, the receiving antenna provides signals to the autotrack receiver which generates input error signals to the attitude control system for spacecraft pointing operations. Beam forming networks (BFN) utilize hopping beams to provide independent coverage of the East and West scan sectors, plus coverage for isolated locations outside of either sector. The MBA also has three fixed spot beams. A steerable beam antenna has been incorporated into ACTS to provide antenna coverage of the entire disk of the Earth as seen from 100 degrees west longitude and to any aircraft or low Earth orbit spacecraft, including the Space Shuttle, within view of the ACTS.

ACTS Deployment Sequence

ACTS will be deployed from Discovery's cargo bay approximately 8 hours after launch on orbit six. The TOS burn which will inject ACTS into a geosynchronous transfer orbit. The spacecraft apogee kick motor will inject ACTS into a drift orbit. Finally, ACTS will be placed in a geostationary orbit at 100 degrees west longitude over the equator, approximately in line with the center of the United States. A geostationary orbit is one where a satellite takes 24 hours to complete one revolution, thus appearing to remain motionless above a single place on the Earth.

About 2 hours before deployment from the orbiter, the astronauts perform a sequence of events beginning with preliminary TOS checks, unlatching the TOS cradle and elevating the ACTS/TOS flight-element to a 42 degree angle for deployment. The crew will fire the "Super*Zip" separation system, and six springs on the TOS aft cradle will push the flight element out of the cargo bay.

The TOS motor firing is controlled by an on-board timer and occurs 45 minutes following deployment from the orbiter or about 8 hours and 45 minutes after STS-51 launch. The approximately two-minute burn will place ACTS in a geotransfer orbit. The apogee kick motor burn to inject ACTS into drift orbit will take place 42 1/2 hours after deployment, approximately 50 1/2 hours into the mission. The 7-day drift will allow ACTS to move toward its final station location of 100 degrees west longitude. Firing of the spacecraft's thrusters will bring the perigee and apogee radii increasingly closer to the geostationary orbit.

Upon reaching geostationary orbit, ACTS will transition from a spinning to a three-axis stabilized spacecraft configuration and deploy its solar arrays and antennas.

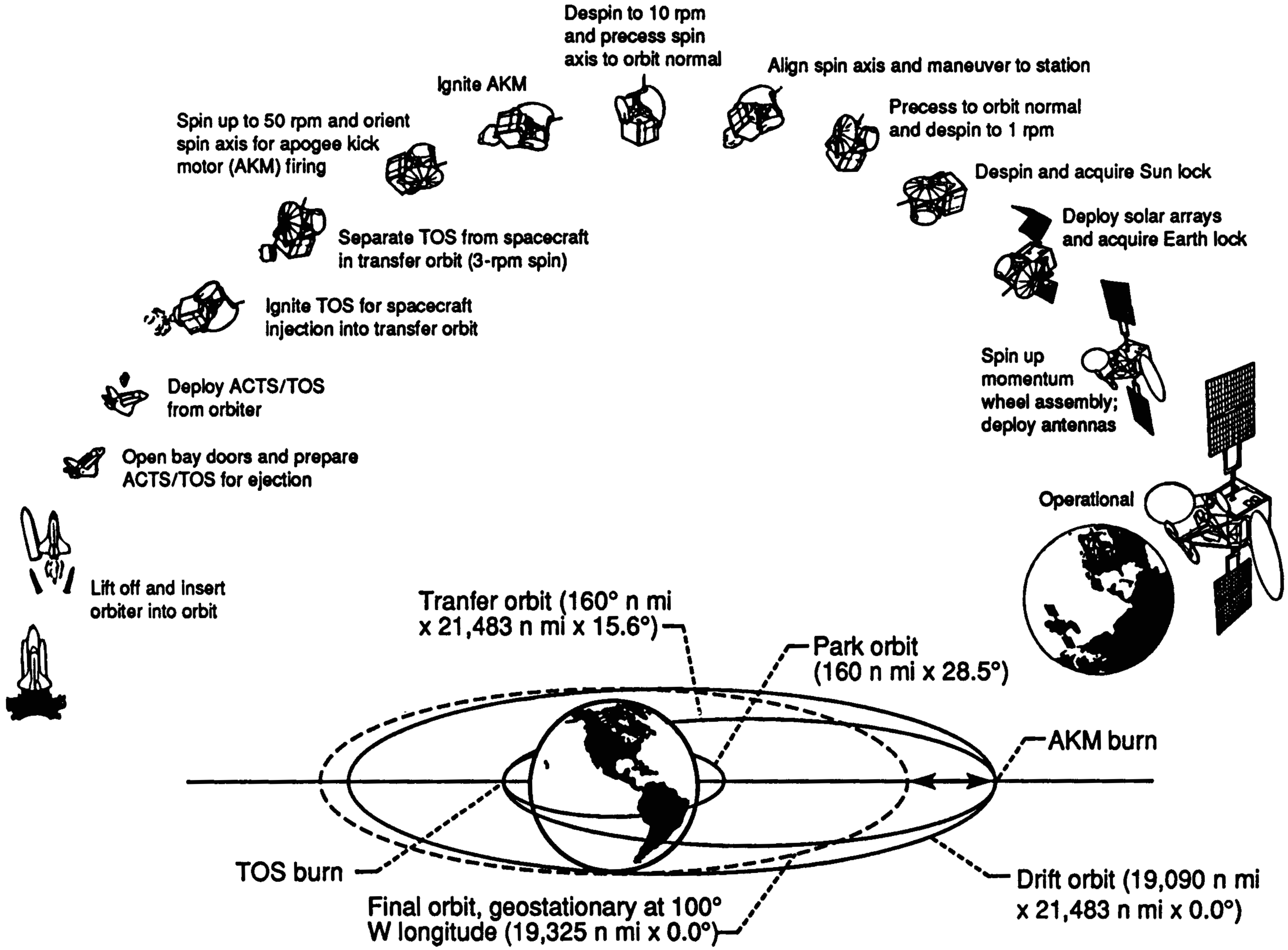
ACTS experiments will begin 12 weeks after launch following the placement of the spacecraft on-station and spacecraft checkout. ACTS is designed to have a minimum life of 2 years but will have enough station keeping fuel for a 4-year-plus mission.

ACTS Ground Systems and Support

The facilities and support to be used for the ACTS mission phases include the Guam and Carpentersville, N.J., C-band telemetry, tracking and command stations and the ACTS ground segment.

Tracking, Telemetry and Command

The ACTS mission telemetry, tracking and command (TT&C) control and monitor functions are distributed between two geographically separate locations: Lewis Research Center, Cleveland and the Martin Marietta Satellite Operations Center (SOC), East Windsor, N.J. The SOC is used to control the ACTS housekeeping functions during both the transfer orbit and the on-station phases.



ACTS mission events sequence.

During the transfer orbit phases, the SOC controls the ACTS through the C-band ground stations. During the on-station phase, command parameters generated at the SOC are routed via landlines to Lewis to be uplinked to the ACTS via Ka-band. Status information is displayed at the Lewis ACTS master ground station for both the transfer orbit and on-station phases.

ACTS Ground Segment

The ACTS ground segment is comprised of the ACTS master ground station, the satellite operations center and the experimenter terminals.

ACTS Master Ground Station

The ACTS master ground station is located at the NASA Lewis Research Center. It includes:

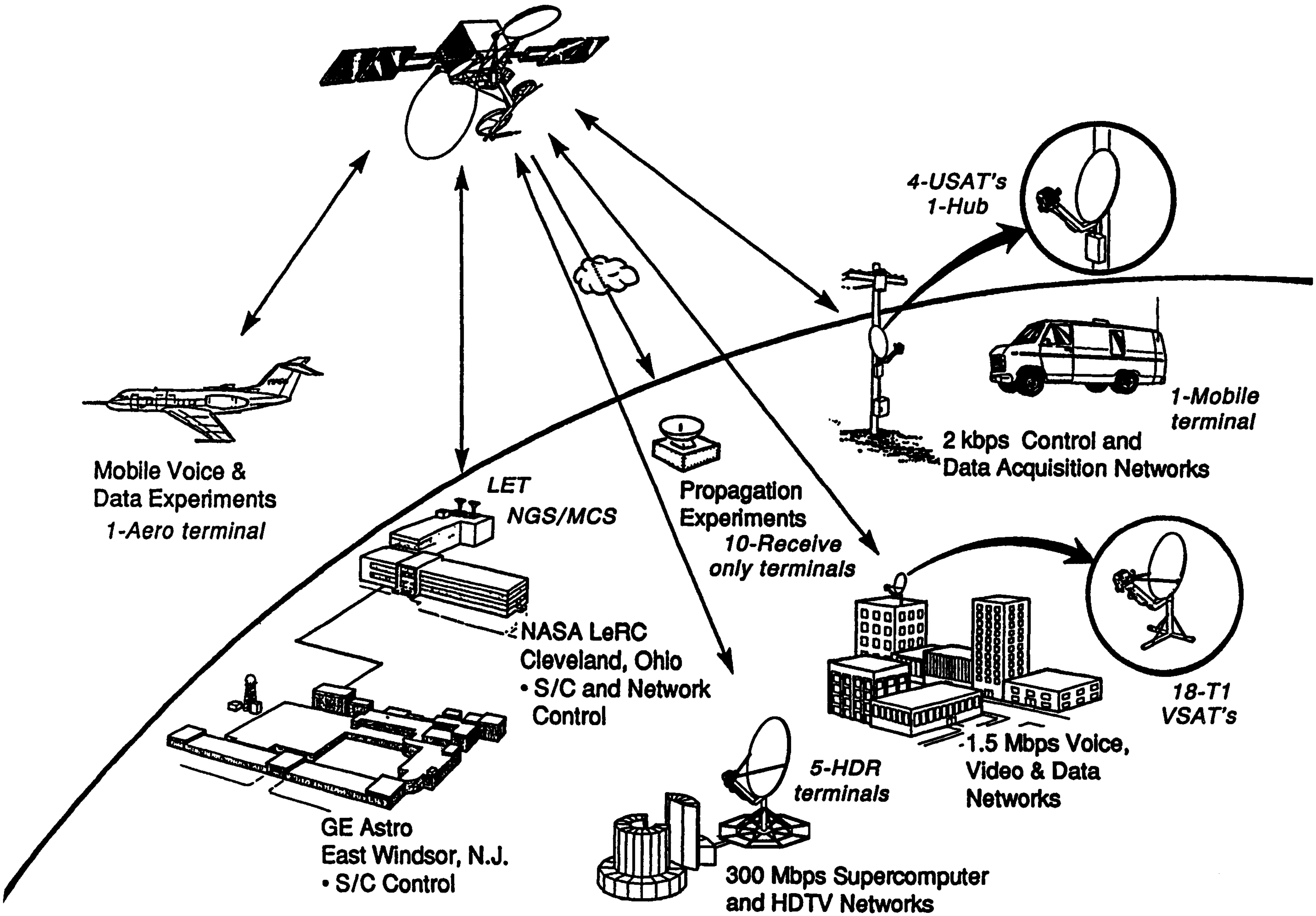
* The NASA ground station (NGS), which consists of a Ka-band radio frequency terminal, two traffic terminals and a reference terminal. It up-converts signals for the baseband processor mode of operations to 30 GHz for transmission to ACTS and amplifies and down-converts the 20 GHz baseband processor modulated signals received from ACTS. Modulation and demodulation of the baseband communications signals are performed in the NASA ground station. It also transmits and receives signals in support of the command, ranging and telemetry functions for ACTS.

* The master control station provides network control for the spacecraft baseband processor and backup to the satellite operations center for configuring the multibeam communications package. The master control station also enables experiment execution and telemetry collection.

* The microwave switch matrix-link evaluation terminal provides the capability for the on-orbit testing of the microwave switch matrix and the multibeam antenna. It also will conduct wideband communications experiments.

* The command, ranging and telemetry equipment interfaces with theNASA ground station at intermediate frequency and exchanges command, ranging and telemetry information to and from the master control station, the G.E. SOC and the microwave switch matrix-link evaluation terminal.

The SOC has primary responsibility for generating flight system commands and for analyzing, processing and displaying flight system telemetry data. Orbital maneuver planning and execution also are handled by the SOC. The primary housekeeping function is performed at the SOC which is linked via land line to the Ka-band command, ranging and telemetry equipment at the ACTS master control station.



Typical ACTS system operating scenarios.

The Ka-band experimenter network consists of a variety of ground stations to be operated by industry, universities and government organizations. These ground stations have varying communication services ranging from High Data Rate (HDR) at 1 gigabit per second, to Very Small Aperture Terminal (VSAT) at 1.5 megabits per second, aeronautical and ground mobile voice and data at 500 kilabits per second and Ultra Small Aperture Terminal (USAT) data at 4800 bits per second.

TRANSFER ORBIT STAGE FOR THE STS-51 MISSION

The Transfer Orbit Stage (TOS) will boost NASA's Advanced Communications Technology Satellite from low-Earth orbit into geosynchronous transfer orbit with a maximum altitude of 21,519 nautical miles (34,624 km). This will be the second mission of the Transfer Orbit Stage and the first time it has flown on a Space Shuttle mission.

The Transfer Orbit Stage was first used in September 1992 as the upper stage booster for NASA's Mars Observer mission. Following launch on an expendable rocket, the TOS successfully propelled the spacecraft on a trajectory from Earth orbit to the red planet.

The Space Systems Projects Office at NASA's Marshall Space Flight Center, Huntsville, Ala., manages the TOS program for NASA. That role involves ensuring TOS compliance with over all mission requirements, including those for integration with the launch vehicle and satellite and flight safety requirements.

Transfer Orbit Stage Description

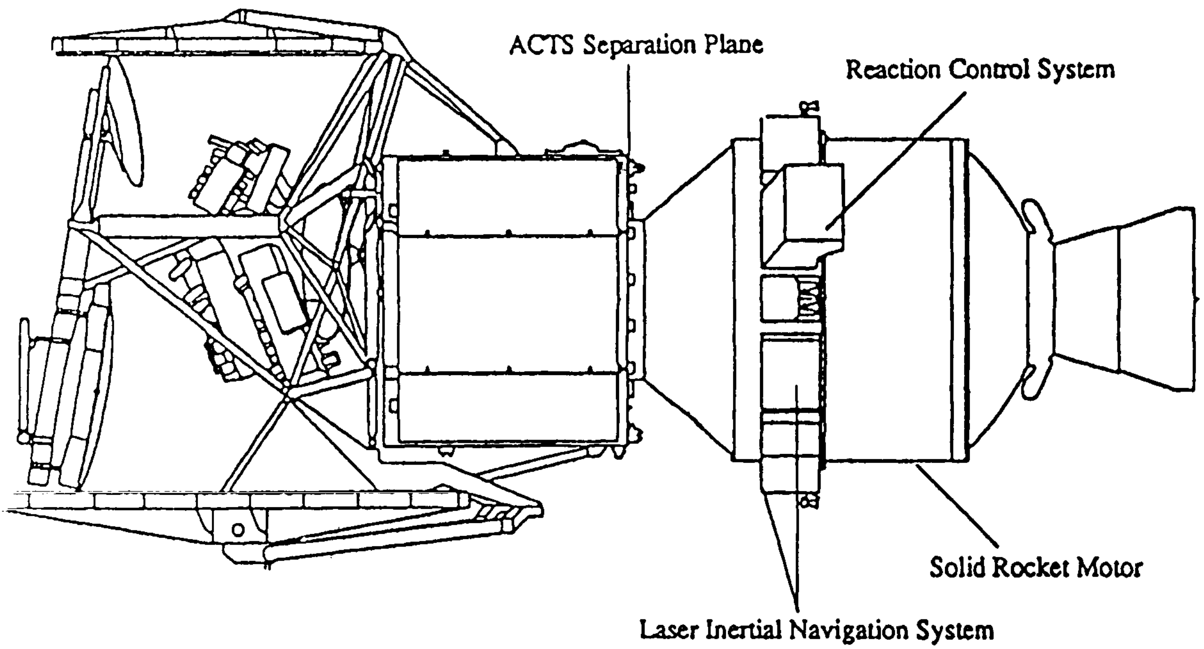
The Transfer Orbit Stage, built by Martin Marietta Astronautics Group in Denver, for Orbital Sciences Corp., Dulles, Va., is a single-stage, solid-propellant rocket system. It is the latest addition to NASA's upper stage fleet, which includes a range of vehicles to boost satellites or spacecraft in the second step of their journey to geostationary orbit or toward interplanetary destinations.

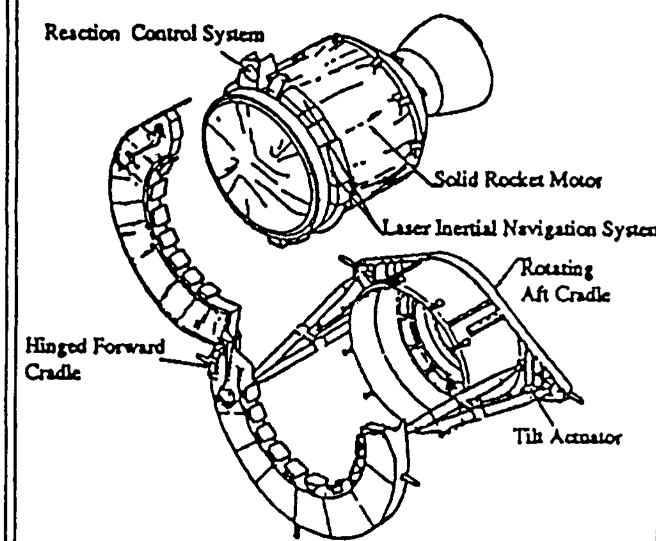
TOS, constructed primarily of high-strength aluminum alloy, weighs 20,780 pounds (9,426 kg) including solid propellant fuel. It is almost 11 feet (3.3 m) long and about 7.5 feet (2.3 m) in diameter. The satellite, weighing 6,108 pounds (2,771 kg), is mounted on top of the Transfer Orbit Stage. Portions of both the satellite and TOS are covered with gold foil multi-layered insulation for thermal protection from the Sun.

Major elements of the TOS system are a solid rocket main propulsion system, a navigation and guidance system, a reaction control system which is used to adjust TOS attitude or local pointing and an airborne support equipment cradle that holds the satellite and upper stage in the Shuttle cargo bay and facilitates deployment from the orbiter.

The ORBUS-21 solid rocket motor main propulsion system, manufactured by United Technologies Chemical Systems Division, San Jose, Calif., will give the

TOS Configuration





TOS and Airborne Support Equipment

primary thrust for the 110 seconds of powered flight. To provide the 59,000 pounds of thrust (262,445 newtons) to inject the satellite into its transfer orbit, the motor will use 18,013 pounds (8,171 kg) of the solid rocket propellant HTPB (hydroxyl terminated polybutadiene).

Pitch (maneuvering upward or downward) and yaw (turning to the left or right) will be controlled during the burn by gimballing the nozzle of the solid rocket motor with two thrust vector control actuators. Roll control is provided by the reaction control system during motor burn.

TOS guidance and control avionics are based on a laser inertial navigation system manufactured by Honeywell, Inc., Clearwater, Fla. It acts as the brains of the vehicle, computing location and providing signals to the propulsion system to maintain the proper trajectory. All TOS operations are performed autonomously with no ground commanding required. The guidance system uses laser gyroscopes with no moving parts, thus reducing chances for malfunctions in space. A telemetry and encoder unit records performance data from all on-board electronics and sends it to ground control at KSC.

The reaction control system thruster assembly, manufactured by UTC/Hamilton Standard Division, Windsor Locks, Conn., correctly positions the TOS and its payload, based on information from the laser inertial navigation system. The three-axis control system uses 12 small maneuvering rockets, which rely on decomposed hydrazine as their propellant, to fine-tune the orientation of the vehicle and its payload before solid rocket motor ignition.

The reaction control system also slowly turns the satellite-TOS for thermal control to avoid overheating from the sun. The reaction control system makes final attitude adjustments before TOS separation from the satellite.

The equipment needed to adapt the satellite-TOS to the Space Shuttle is called the airborne support equipment. This equipment is manufactured by Martin Marietta. Prior to deployment, the TOS rests in the aft cradle and is clamped firmly in the Shuttle's cargo bay by the forward cradle.

ACTS/TOS deployment scenario

During the STS-51 mission, Discovery crew members will initiate a predeployment checkout to ensure that all critical TOS systems are healthy and ready to deploy. The upper forward cradle, similar to a clamp, will then be unlatched and rotated open. The satellite-booster will be elevated 45 degrees out of the cargo bay. If any problems are detected in the combined payload up to this point, it can be lowered, relatched and returned to Earth at the end of the mission. If no anomalies are detected, a pyrotechnic system will release the satellite-TOS and springs on the cradle will gently nudge it out of the orbiter. The satellite-TOS will coast for 45 minutes while the Shuttle maneuvers to a safe distance, 11.7 miles (18.8 km) away, to avoid a possible collision or damage from the TOS solid rocket exhaust plume.

Once the Transfer Orbit Stage has positioned the satellite in the proper attitude, the TOS solid rocket motor will fire for 110 seconds, accelerating to the

22,800-mph velocity (36,685 km/hr) necessary to boost the satellite into its geosynchronous transfer orbit. Then the Transfer Orbit Stage will make final attitude adjustments as the satellite speeds toward apogee, the point farthest from the Earth in its orbit.

Shortly after rocket burnout, the satellite will separate from the TOS and the TOS will make a perpendicular turn to avoid being in the satellite's path. Later, thrusters and a solid rocket motor on the satellite itself will fire to place the satellite into its final geosynchronous orbit. The actual timing of the satellite burn is controlled by commands from the ground.

Extra-Vehicular Activity Tools

If a mechanical problem with the TOS airborne support equipment were to develop prior to or after deployment of the satellite-TOS, two astronauts can use one or more specially designed tools to correct it. The tools were designed at Marshall Space Flight Center and tested under simulated weightless conditions in the center's Neutral Buoyancy Simulator water tank. The actual use of these devices is considered unlikely since the airborne support equipment itself is fully redundant, with all systems having built-in back-ups.

ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS) EXPERIMENTS PROGRAM

The Advanced Communications Technology Satellite Experiments Program gives industry, academic, and government organizations an opportunity to investigate new ways of communicating. In conjunction with industry, NASA has developed the ACTS and an extensive network of ground stations to test and prove pioneering communications concepts and technologies that will advance cheaper, on-demand, flexible communications.

The Experiments Program provides access to these new telecommunication tools that will be widely used in the 21st century. ACTS experimenters design, fund, and conduct investigations. NASA contributes spacecraft time, manages operations, and assists investigators in developing a final experiment plan. This partnership brings the capabilities of this unique national resource to regional telecommunications users.

The goals of the program reflect national priorities in advancing technology development and promoting U.S. competitiveness in international markets. The program will conduct technical verification experiments to prove the high-risk technology and a balanced set of experiments which evaluate the potential applications of the technology.

Experiments have been selected that meet these goals and challenge the ACTS system. The results of these investigations could yield numerous benefits to business, health care, education, national defense, and emergency/disaster relief and advance the technology in high data rate communications. The following describes ACTS's contribution to these areas and candidate experiments. (The experiments listed below have been officially accepted into the ACTS Experiments Program at press time.)

Business Advantages

Communications is an essential element of any community's infrastructure, but in business it can be the factor that promotes profit or inhibits growth. Expanded communication capacities such as fax machines and electronic information networks have revolutionized the way the business is conducted around the world. The ACTS Experiments Program provides an opportunity for business to test new technologies that may lead to more efficient ways to operate and create new services.

With the advent of ACTS, a new generation in communications technology will bring benefits to business. ACTS-type technologies will increase efficiency and lower the cost of business communications by enabling real-time communications and the use of smaller satellite dishes. It can augment fiber-optic networks to extend communications capacity to remote areas, creating new telecommunications users and enhancing the "information superhighway" with Earth-space linkages.

EXPERIMENTS

The ACTS Program has developed and will validate, by flight testing, high risk advanced communication satellite technologies. The validation of these technologies is to be accomplished through the ACTS Experiments Program. The ACTS flight and ground systems will be made available to the public and private sectors (industry, universities and government agencies) for evaluation, experimentation and demonstration of key technologies and their applications after launch. A formal 2-year Experiments Program currently is planned, including:

* demonstrate the commercial viability and market acceptability of new voice, data and video networks and service with ACTS
* verify the on-orbit performances of the advanced technology components of the ACTS flight system
* demonstrate and evaluate the system networking aspects of the switching and processing technology
* characterize the Ka-band transmission medium and develop techniques to combat signal fade and attenuation

To date, some 60 experiments have been approved to use the ACTS system. These experiments represent 86 principal investigators and co-investigators from over 61 different organizations.

The following table breaks down the application experiments category into a number of sub-categories and lists the number of experiments currently planned for each.

Application Experiments Categories

Business Networks	7
Medical	3
Integrated Services Digital Network	4
Public Switched Network	3
Education	1
Video/Teleconferencing	1
DOD Strategic/Tactical	2
Gigabit Networks	3
High Definition TV	1
Supervisory Control and Data Acquisition	1
Land Mobile	6
Aeronautical Mobile	1
Science	3
Network Protocol	1
TOTAL	**37**

American Express
Availability Comparison Between Ku and Ka Satellite Technologies

American Express is interested in testing the ACTS very-small aperture terminal (VSAT) technology to determine if it will be a viable future business option for transactions. ACTS will operate as a data channel between facilities in Phoenix, Ariz., and Mexico City, Mexico. American Express has an existing Ku-band link between these sites and wants to compare the performance of the ACTS Ka-band T-1 VSAT (capable of higher data rates, 1.544 Mbps, with a smaller terminal) to its current system. Contact: Thomas Marshall, 602/492-4321.

Southern California Edison
Low Cost SCADA Network
Affiliated Organizations: Weber State University, Wasatch Research

Southern California Edison (SCE) is working with NASA Lewis Research Center to build and test an ultra-small aperture terminal (USAT) that operates at Ka-band for use in a supervisory control and data acquisition (SCADA) network. Weber State University will conduct the tests of the terminal with both Ku- and Ka-band antennas and will compare performance.

The spotbeam antenna technology of ACTS makes it possible to use smaller terminal apertures. SCE is investigating the Ka-band USAT to determine its suitability for use with electric utilities and other industries. Contact: Dr. Roosevelt Fernandes, 818/812-7305.

Ohio University
Disaster Recovery, Backup, and Communications Augmentation Experiment Using ACTS
Affiliated Organizations: Huntington Bank, SUNGARD Recovery Services, Inc., Unisys Corporation, Ascom Timeplex, Inc.

Ohio University will conduct tests with ACTS to help Huntington Bank recover from a "simulated" natural or other disaster, thus protecting it against a total loss of communications. ACTS will transmit financial data such as deposits, account balances and transfers of funds. The experiment will determine the reliability of the data link and the ability to switch over to a backup communications system within an acceptable period of time as well as the economical advantages of using such a system. Contact: Dr. Don Flournoy, 614/593-4866.

COMSAT World Systems
Prototype INTELSAT Operations

Affiliated Organization: INTELSAT

This experiment will provide operational experience with ACTS technology to potential service providers, earth station owners, and users, emphasizing the use of Ka-band and onboard signal processing. The reliability and transmission quality of Ka-band will be compared with C- and Ku-bands to determine feasibility of future use. Contact: A.M. Goldman, Jr., 202/863-6601.

Jet Propulsion Laboratory
ACTS Aeronautical Experiment
Affiliated Organizations: Air Force Rome Labs, Boeing Defense and Space Group, GE Electronics Laboratory, Texas Instruments

The Jet Propulsion Laboratory (JPL) will demonstrate a 4.8 kbps voice and data link between an aircraft and a fixed terminal using phased-array antennas. This experiment will evaluate ACTS spotbeam technology, the ACTS Mobile Terminal (AMT), and phased-array antennas for use in aeronautical communications. Aeronautical communications could be an important new growth area in the telecommunications industry. Contact: Brian Abbe, 818/354-3887.

Baseline Land-mobile Experiments

JPL will conduct multiple mobile communications experiments demonstrating various applications involving voice, data, and slow-scan video. They will evaluate the commercial viability of system concepts and perform propagation measurements. The main purpose is to evaluate K/Ka-band feasibility for mobile applications. Contact: Mr. Tom Jedrey, 818/354-5187.

Dataflow Systems
Direct-to-Premises ACTS-based Video Services
Affiliated Organizations: University of California-Berkeley, Mississippi State University

Dataflow Systems will investigate two-way, direct-to-premises static and motion video services with ACTS, based on low cost, low power workstations. Such services are needed to communicate images between offices during normal business operations or in emergency situations. Some of the possible applications include: multimedia conferencing between remotely located CAD/CAE design teams, doctors in surgery, lawyers in court, and industrial process control teams. Also, use of ACTS would enable on-demand and dynamic database browsing and copying. Contact: Dr. Vason P. Srini, 415/527-7183.

Public Broadcasting Service
High Definition Television and Video Demonstration

The Public Broadcasting Service (PBS) will use ACTS to transmit high definition television (HDTV) and digital video signals from PBS to member stations. Member stations could then distribute the signals via terrestrial transmitters or cable TV. PBS will be experimenting with the High Data Rate terminal -- the only ground station available capable of transmitting HDTV signals.

In another test, PBS would transmit via ACTS from member stations to a small area to demonstrate the feasibility of local direct broadcast satellite service (DBS) within a single city or market region. Contact: Mr. Carl Girod, 703/739-5483.

COMSAT Laboratories
Integrated Services Digital Network (ISDN) Experiments

In this experiment, COMSAT will demonstrate the ability of satellite communications to provide state-of-the-art commercial telecommunications services. The experiment is designed to test the viability of providing a variety of services and teleservices via ISDN using an ACTS-type system. COMSAT will measure the performance of the ACTS ISDN technology and its network capabilities. Contact: Moorthy Hariharan, 301/428-7747.

University of Florida
Narrow band ISDN Applications Using ACTS

The relationship between ISDN and satellites is complementary. ISDN provides satellite networks with a single access point into multiple ground networks. On the other hand, satellite systems provide increased geographical coverage for ISDN. ACTS's advanced features enhance this relationship by increasing flexibility of connectivity, network efficiency, and quality of service.

The University of Florida will conduct three narrow band ISDN-related investigations which can be implemented using ACTS: video teleconferencing, performance evaluation of High-Level Data Link Control (HDLC) protocol over a Ka-band satellite channel (which will study the effect of rain fade on this protocol with respect to its various control functions such as addressing, frame numbering, error recovery, and flow control), and Local Area Network interconnection. Contact: Dr. Haniph A. Latchman, 904/392-4950.

NASA Lewis Research Center
North American ISDN Users' Forum (NIUF) Demonstration
Affiliated Organizations: A consortium of users and telephony industry, including: Bellcore, Regional Bell Operating Companies, AT&T

This experiment will demonstrate ACTS ISDN services to NIUF members. It will involve the use of a T-1 VSAT transportable link back to Lewis Research Center, JPL, and other ACTS ISDN transportable nodes. The primary application demonstrated will be PC-based multimedia teleconferencing. Contact: Tom vonDeak, 216/433-3277.

NBC
Satellite News Vehicle (AMT) Experiment
T-1 VSAT Backhaul Experiment
Affiliated Organization: JPL

NBC will investigate mobile and fixed terminal capabilities for providing increased communications for people in the satellite news industry, specifically while enroute to and from news sites. The experiments will determine how many "hops" can be made between points before image quality degrades beyond acceptable levels.

The fixed experiment involves using several T-1 VSATs to provide multiple "hop" communications, transmitting the same images from point to point between different broadcast locations. The mobile experiment will evaluate the ACTS and AMT technologies for remote communications purposes, e.g., from a news bureau to a satellite news vehicle. Contact: Robert Sisko, 212/664-6186.

IDB Communications Group
Satellite News Gathering Land-Mobile Experiment/Demonstration
Affiliated Organization: JPL

IDB Communications is interested in showcasing the ACTS and AMT technologies for remote broadcast purposes. This experiment/demonstration will be a live transmission of IDB Communications' network-fed broadcast via ACTS. It will occur at the National Association of Broadcaster's Convention in 1994. Contact: David Anderson, 213/240-3726.

Bellcore
Experimentation with Satellite-based Personal Communications Services (PCS)
Affiliated Organization: JPL

The goal of this research effort is to demonstrate the capabilities of satellites for enhancement of ground-based personal communications voice and data services. The experiment will determine the ways in which local exchange network providers can interface to wireless service providers and the kinds of services that should be offered.

The applications being investigated include: two-way messaging, delivery of personalized information services, use of satellites to alert nomadic end users of incoming telephone calls. It will also test the combined capability of satellites plus Global Positioning System service to locate nomadic end users, update network databases, and route calls and/or messages to their current location. Contact: Richard Wolff, 201/829-4537.

Florida Atlantic University
ACTS Wide Bandwidth and Video Compression Experiments

The primary goal of this experiment is to demonstrate the use of ACTS for commercial video data transmission. Florida Atlantic University will use video compression techniques developed by the University and will test the reliability and feasibility of ACTS to provide this commercial service. Contact: Dr. Henry Helmken, 407/367-3452.

Martin Marietta Astrospace
Business Telecommunications for Potential Customers

Martin Marietta Astrospace will be allowing potential customers to evaluate the Ka-band frequency for business communications. Martin Marietta has purchased a ground station for its facility in East Windsor, N.J., in order to experiment with ACTS. It is identifying various areas for investigation. Contact: Frank Gargione, 609/490-2337.

HEALTH CARE ADVANTAGES

Availability of quality health care is a primary concern to people everywhere. When a patient is not able to get to health facilities or when specialists are not available for consultation, precious time is wasted. Improved and expanded telecommunications can help overcome distance barriers, improve upon local facilities, and extend medical services to more people, while maintaining reasonable costs.

The ACTS Experiments Program is working with medical personnel around the country to test delivery of health care services to remote locations and to demonstrate the use of more sophisticated mobile communications. ACTS will transmit images and information to physicians and specialists for use in diagnoses. High-resolution medical imagery from X-rays, MRIs, or CT scans can be sent to another location for review by a consulting physician. The ACTS Mobile Terminal (AMT) will also be used to transmit patient data from emergency vehicles while en route to a hospital.

EXPERIMENTS

Mayo Foundation

Application of the NASA ACTS Satellite System to the Practice of Medicine in an Integrated Group Practice

Affiliated Organizations: U.S. Army Medical Diagnostic Imaging Support

The Mayo Foundation will be using ACTS to investigate communication techniques which may eventually allow large medical centers to provide supporting medical services to small and medium-sized medical facilities in small towns and rural areas. The objective of the experiment is to demonstrate that the provision of quality medical diagnostic and information services to remote facilities can be cost effective and timely.

It has become essential to be able to communicate and transmit data from one medical facility to another to enhance the quality of care for individual patients and to seek consultation from experts who may be at a distant location. Mayo will be investigating a variety of medical applications including image, data, and voice transmission. They will use ACTS to transmit in real-time medical imagery and other patient test information for diagnosis. The on-demand flexibility, wide bandwidth, ISDN and high data rate capabilities of ACTS could solve many medical outreach problems. Contact: Dr. Robert Hattery, 507/284-9425.

Georgetown University School of Medicine

Remote Radiology

In this experiment, Georgetown University will transmit magnetic resonance images (MRI) and radiological images from Tripler Army Base in Hawaii to Washington, DC. Tele-education will also be provided for radiologists and radiologists-in-training. The experiment may be expanded to include transmission to South America. Contact: Dr. Seong K. Mun, 202/687-5990.

NASA Lyndon B. Johnson Space Center
Application of Small Earth Stations in Conducting Telescience and Telemedicine
Affiliated Organizations: Krug Life Sciences, University of Colorado

Johnson Space Center will use ACTS to test the utility of advanced satellite technology for conducting telemedicine, telescience, video conferencing, and high resolution image transfer. Specifically, the experiment will generate images of the interior of the eye. The images will then be transmitted to another location via ACTS for analysis. Contact: Dr. Gerald Taylor, 713/280-0469.

EMSAT: Advanced Technology for Emergency Medical Services
Emergency Medicine Land-Mobile Satellite Experiment (EMSAT)
Affiliated Organizations: JPL

EMSAT will evaluate the feasibility of mobile satellite communications for pre-hospital communications. Experiment objectives are to demonstrate and assess the transmission and reception of satellite digital voice for two-way, pre-hospital communications, one-way transmission of patient data from field paramedics to the base hospital, and telemetry of patient assessment data to the base hospital. Factors that affect pre-hospital satellite communications will be studied. Contact: Bruce P. Jackson, 818/842-0207.

University of Washington
Mobile Radiology Image Transfer
Affiliated Organization: GE Medical Systems

This experiment will link a mobile Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) van to the Department of Radiology at the University of Washington Medical Center. The mobile van will transmit digital medical images (while stationary) from various locations in the state of Washington. This investigation will allow for quality control and for diagnostic consultation and interpretation of the remotely obtained images at a major university medical center. This use of ACTS demonstrates a practical medical application of teleradiology from remote locations to medical centers. Contact: Dr. Stephen J. Carter, 206/685-2693.

ACTS/AMT Telemedicine Experiment
Affiliated Organization: JPL

This experiment involves the transmission of CT and MRI images to the University of Washington via ACTS using a portable computer with the AMT, the fixed terminal located at NASA Lewis Research Center (LeRC), and a telephone line from LeRC to the University of Washington Medical Center. The received images will be filmed with a laser camera and compared with original films. The transmissions will be performed during various weather conditions and at multiple locations throughout rural Washington state. Contact: Dr. Stephen J. Carter, 206/685-2693.

Lister Hill National Center for Biomedical Communications
National Library of Medicine
National Institutes of Health
VAMA: VSAT Access to Medical Archives
Affiliated Organization: University of California at San Francisco, School of Medicine

ACTS offers the opportunity to experiment with techniques and procedures suitable for a communications environment that allows real-time access to critical medical information. Current access to medical archives at the National Library of Medicine is achievable through INTERNET. However, the transmission rate is such that real-time interaction and selection of information is not possible.

A set of experiments will test prototype systems for the rapid transfer of medical images across widely-separated geographical areas. Two possible experiments: test a prototype medical information system to provide remote access to a national medical database in real time and demonstrate a system to rapidly and accurately transfer a large volume of uncompressed digital x-ray image files. Contact: Mr. Rodney Long, 301/496-4496.

LONG DISTANCE EDUCATION AND TRAINING

Education and training are key to increased knowledge and productivity. In this era of changes in the economy and the workplace, students and workers, with increasingly limited time and resources, will need to have better access to educational and training facilities. ACTS-type technology can provide real-time, more advanced communications capability to the classroom or the workplace. It can also tap into information networks faster and transmit that information quicker than current communications systems.

Some ACTS experimenters will be investigating the use of long-distance, real-time, interactive communications to educate people outside of major learning institutions. They will test the capability of ACTS to deliver instruction to interested students in different areas in the United States and in South America. Other experimenters will use ACTS to provide special training. ACTS-type service could create new educational networks.

EXPERIMENTS

Georgetown University
Georgetown Technical Hemispheric Intercultural Network for Knowledge (G-THINK)
Affiliated Organizations: Inter-American Development Bank, IBM, Citibank, Martin Marietta Astrospace, Loral, Andres Bello University, Catholic University, Javeriana University, Latin America Institute of Doctrinal and Social Studies, Sophia University

Georgetown University will investigate the viability of two-way, interactive distance learning, involving programs that are medical, scientific, or research in nature. ACTS will be used to demonstrate distance education to four South American sites in Columbia, Ecuador, Venezuela, and Chile.

Georgetown will also conduct distance education projects in the United States in the areas of medicine, business, teleradiology, library database access, veterinary medicine, and remote sensing. Contact: Rev. Harold C. Bradley, S.J., 202/687-3455.

NASA Kennedy Space Center
Distance Learning in the Area of Hazardous Materials and Environmental Safety
Affiliated Organizations: Lockheed Space Operations Company, University of Central Florida

This experiment involves distance learning in the area of hazardous materials and environmental safety. ACTS will link Dryden Flight Research Facility, Calif., and Kennedy Space Center, Fla., for approximately 10 hours of training to Lockheed employees. The experiment consists of distance learning classes using lecture, graphics, and videotape. It will test the quality of video and audio and effectiveness of Ka-band for distance learning. Contact: Darwin V. Brown, 407/867-7293.

Florida Agricultural and Mechanical University
Distance Learning

ACTS will be used to link the College of Pharmacy at Florida A&M University (FAMU) in Tallahassee with the FAMU Clinical Training Unit located in Miami and allow for the instruction of students. The experiment will involve two-way voice and video transmission and will be divided into two 16-week and one 13-week segments. Contact: Johnnie L. Early, 904/599-3301.

IMPROVED NATIONAL DEFENSE AND EMERGENCY/DISASTER COMMUNICATIONS

In the Persian Gulf war and the aftermath of Hurricane Andrew, the United States reaffirmed the value of advanced military and disaster communications. Secure and reliable communications provided necessary advantages to American troops in executing quick and successful air and ground attacks, while minimizing casualties. In severe contrast, lack of immediate and adequate communications capability severely hampered the relief efforts in Florida and Louisiana.

Experimenters with ACTS will gain insight into improved military and emergency/disaster communications by testing new concepts. The use of the ACTS Mobile Terminal can restore communications capability immediately. ACTS T-1 VSATs can be used to restore damaged points within the Public Switched Network.

Military and emergency communications can benefit from the real-time, higher communications capacity demonstrated by the ACTS system.

EXPERIMENTS

National Communications System

Public Switched Network (PSN) Restoration
PSN Trunking
Isolated User Access
Secure Mobile Communications
Affiliated Organizations: MITRE Corporation

The National Communications System (NCS) experiments will demonstrate the capability to restore or augment communication networks. It is the responsibility of the NCS to coordinate the planning for and provision of communications services to a set of National Security/Emergency Preparedness (NS/EP) users. NCS initiated the Commercial SATCOM Interconnectivity (CSI) program in 1983 in response to a Presidential directive stating that CONUS-based commercial satellite communication resources should be exploited to augment and restore Government communications capabilities during times of emergency. ACTS will be used to investigate new advanced satellite communications technologies.

The first three experiments examine restoration of the PSN when disrupted. The first restores communications at the point where loss of connectivity occurs or augments existing capability when needed. The second experiment provides point-to-point trunking via ACTS for NS/EP users when disruption occurs in the PSN inter-exchange carrier switches. The third experiment will demonstrate ACTS's ability to communicate with isolated users by restoring communications between local carriers in the PSN and inter-exchange carrier switches. The final experiment utilizes the AMT capability to restore communications in areas affected by disaster. Contact: Mr. Frank Dixon, 703/692-0540.

U.S. Army Space Command

Army ACTS Experiments
Affiliated Organizations: Combined Arms Center, Department of the Army/Army Space Institute, Laboratory Command/Army Space Technology Research Office, U.S. Army Communications Electronics Command, U.S. Army Information Systems Engineering Command, U.S. Army Future Battle Lab, U.S. Army Medical Diagnostic Imaging Support

The Army ACTS experiments will be incorporated into the Army Space Demonstration Program which demonstrates space systems capabilities to support AirLand Battle Doctrine. The Army will use ACTS to overcome various operational communications shortfalls. A complete set of verification experiments will be conducted to evaluate ACTS technologies and interactions with ground communication systems. The experiments will explore a variety of uses including video teleconferencing; transfer of large imagery, geographic/meteorological information, logistics, and medical databases; remote training; transmission of video, voice and data to the field; and testing of mobile communications. Contact: Pete Cafaro, 719/554-8717.

U.S Army Topographic Engineering Center
Use of ACTS for Communicating Differential GPS
Affiliated Organization: Rockwell International

U.S. Army Topographic Engineering Center (USATEC) is conducting an experiment using the Global Positioning System (GPS). GPS uses satellite signals to calculate a position on earth and is subject to several sources of error. These errors remain relatively constant within a specific region, and a set of corrections can be generated at one location and applied to another. USATEC via ACTS will transmit these corrections to users in real-time. They will analyze time delay, transmission quality, bit error rate, and cost and convenience of terminal location and satellite acquisition. Contact: Andrew Austin, 703/355-2765.

U.S. Army Research Labs
Integrated Services Digital Network (ISDN) via Satellite
Affiliated Organization: Georgia Tech Research Institute

This experiment evaluates ACTS' ability to provide ISDN connectivity among a geographically-dispersed population of end users. It will provide real-time networking of ISDN users via satellite and multimedia desktop video teleconferencing. The ACTS system will be compared to a terrestrial DoD ISDN baseline system. Contact: Dr. Jay Gowens, 404/894-3137.

EXPANDING SCIENTIFIC RESEARCH NETWORKS

Scientific research can be greatly facilitated and augmented by improved communications capability. The majority of scientific research is conducted in remote areas that are not accessible by modern transportation or fiber-optic cable. With ACTS-type technologies, researchers could gain access to remote databases that contain needed information. Researchers would also have the ability to communicate in real-time with other scientists in the field to obtain results from experiments or to consult on a problem. Mobile communications could benefit researchers by providing a transportable link to laboratories or universities.

Experimenters in the ACTS Program will be investigating the use of new communication techniques in conducting scientific research. From operating remote laboratories to simply transmitting needed information from Arctic climates, ACTS can improve the way scientists operate and make it easier to distribute scientific results.

EXPERIMENTS

New Mexico State University
Real-Time, High-Bandwidth Data Links

ACTS will provide a high-bandwidth, real-time link to gain access and control of an astronomy telescope located at the Apache Point Observatory in south-central New Mexico by a remote user within the continental United States. The user will not have to be on-site during the observation period. The present mode of access to the observatory is through commercial, land-based telephone lines.

New Mexico State University will look to ACTS to give the user a "touch and feel" for remote access and control and to provide the high-rate capacity needed for data transmission from a new, deep-sky telescope which will produce continuous, digital data from an array of sensors. They will also test ACTS for non-real-time data networking to support observatory management, database sharing, computer conferencing, and similar services for the science community. Contact: Dr. Stephen Horan, 505/646-5870.

National Science Foundation
Antarctic Researcher Support
Affiliated Organization: University of California-Santa Barbara

ACTS would provide an advanced communications link between Palmer Station in the Antarctica and U.S. laboratories. It would also provide access to the INTERNET and high quality voice communications, allow rapid and relatively large transfer of data, and permit access to high data rate satellite information such as SAR sea-ice images. It would also allow for off-station logistics and scientific support, database management, data analysis, and open Palmer to as yet untapped educational opportunities. ACTS would contribute to increased researcher productivity thereby decreasing the number of researchers needed on-site and would provide a greatly needed link to the outside world from Palmer's remote location. Contact: Dennis Peacock, 202/357-7894.

George Washington University
Supercomputer Networking Applications
Affiliated Organizations: COMSAT Laboratories, Cray Research, NASA Goddard Space Flight Center (GSFC), Jet Propulsion Laboratory

George Washington will use ACTS to demonstrate the ability of satellites to support high data rate communications such as distributed supercomputer applications. JPL will be able to access GSFC's supercomputer facilities to enable oceanic/atmospheric modeling. Also, supercomputers will be linked to accelerate weather forecasting. The experiments can simulate Earth and space science processes, create real-time visualization of the data, and distribute the data through a wideband data communications network. Contact: Dr. Burt Edelson, 202/994-1431.

Pacific Space Center (PacSpace) and University of Hawaii
Advanced Applications to Validate ACTS Technologies
Affiliated Organizations: Argonne National Laboratory, Hawaii Space Development Authority

The State of Hawaii faces unique communication problems caused by distance. PacSpace will utilize ACTS to help solve some of these problems and to perform a range of experiments. They will use the high capacity of an ACTS ground station to support other on-going programs at the University of Hawaii, involving image processing and management, high performance computing and communications, oceanic research, and integration of advanced communications networking.

Experiments will test the practicality of remote access to large image databases for scientific, military and educational information. They also will test transfer of scientific research data to central facilities. Contact: Dr. David Yun, 808/533-1539.

ADVANCING TECHNOLOGIES AND U.S. COMPETITIVENESS

The ACTS Program has and will continue to contribute to the development of advanced technologies. Since ACTS will operate at the Ka-band frequency, off-the-shelf Ka-band components are now available. The spotbeam and onboard switching and processing technologies developed for ACTS have already in part been adapted for use in planned communication systems. American research efforts in high definition television (HDTV) and in integrated services digital networks are also being advanced by ACTS technology development. Smaller ground stations that transmit at higher data rates have been created for use with ACTS. The proving ground for all of these technologies is the ACTS Experiments Program. The testing and performance of the technology could yield important results that will impact future communication systems in years to come.

ACTS technology not only advances the state-of-the-art but also strengthens U.S. competitiveness in the international telecommunications market. Since 1982, the U.S. share of the communications satellite and equipment market has shrunk in the face of increased competition from European and Japanese companies. NASA, in conjunction with industry, government and academia, developed the ACTS and its associated ground system to advance the U.S. competitive position in technologies expected to be widely used in the 21st century.

EXPERIMENTS

Advanced Research Projects Agency
High Data Rate Terminal Development and Experiments

The Advanced Research Projects Agency (ARPA), in a cooperative effort with NASA, has sponsored the development of the High Data Rate (HDR) terminal as part of a satellite research testbed network using ACTS and in support of the federal High Performance Computing and Communications (HPCC) program.

The HPCC was developed as a multi-agency effort for the purposes of extending U.S. technological leadership in high performance computing and computer communications and of providing wide dissemination and application of these technologies.

One element of the HPCC program is the development of technology for wide area gigabit (one billion bits per second) data networking. ARPA has the responsibility for coordinating the multi-agency research effort to achieve this capability. Also, ARPA has strong interests in investigating very high speed satellite/terrestrial communications for defense applications. NASA believes that satellites can render significant service in hastening the development of high data rate applications for commercial and government use.

In order to achieve mutual goals, ARPA and NASA supported the development of the HDR terminal and experiments to challenge network capabilities and promote the state-of-the-art in this area. The HDR experiments are intended to demonstrate new capabilities and the functionality of high-speed communications.

The ARPA HDR experiments will investigate the linking of satellite and fiber networks, the real-time user interaction with complex climate models created with supercomputer visualization, military applications, and the distribution of medical imagery. Experiment collaborations are currently being developed with:

Ohio Supercomputer Center
Public Broadcasting Service
National Center for Atmospheric Research
U.S. Army Future Battle Lab
Army High Performance Computer Research Center
Mayo Clinic
Georgetown University
University of Hawaii

Contact: Paul Mockapetris, ARPA, 703/696-2262.

National Telecommunications and Information Administration (NTIA)
Institute for Telecommunication Sciences
Quantify ACTS End-to-End Communication System Performance

The primary objective of NTIA's experiment is to measure and quantify the end-to-end digital communication system performance of ACTS from the end user's perspective. The experiment will also provide documented knowledge of advance communication satellite system performance. These measurements will be used to establish a baseline measure of performance of ACTS. This quantification of the ACTS system will enable performance comparisons of advanced satellites with other telecommunications technologies, e.g., public data networks and conventional communication satellite systems.

This performance data will be used by NTIA/ITS to help develop national and international telecommunication standards that will strengthen the use of advanced communication satellites in telecommunication networks. Future networks may incorporate satellites in a hybrid network design where a satellite provides back-up and restoration services as well as thin-route and mobile communications. Contact: Marjorie Weibel, 303/497-3967.

Motorola, Inc.
BBP Transmit Window Characterization
High Burst Rate Modem Evaluation
Coding Gain Evaluation

Motorola will be conducting a series of experiments to technically challenge the ACTS system. In the first experiment, it will measure the times of data arriving at the ground station while varying transmit time in order to evaluate ACTS link erosion due to orbital variations and clock accuracies.

The second experiment will test Motorola's modem technologies through the ACTS microwave switch matrix channel which is capable of higher data rates. Motorola will use advanced modulation techniques and coding to maximize bit error rate performance.

The last experiment will investigate the effect of coding on ground station transmissions. Data will be transmitted in coded and uncoded modes, and bit error rates will be measured. The data will be evaluated to determine the advantage realized by coding techniques. Contact: Kerry Lee, 602/732-2299.

COMSAT Laboratories
Demonstration of Advanced Networking Concepts
Affiliated Organization: INTELSAT

The trend toward utilizing smaller ground station antenna sizes and increasing the use of higher frequency bands has focused attention on methods for overcoming rain-induced degradation of the satellite signal. One method is to integrate a number of VSATs through a Metropolitan Area Network (MAN) into a Wide Area Diversity (WAD) Network.

The objective of this experiment is to identify whether Ka-band VSATs can achieve error performance and availability levels defined for an international ISDN connection, despite the propagation conditions in these bands, based on the networking method described above. Successful penetration of satellite-distributed communications services into existing and new markets hinges on two factors: economics and quality of service. Economy can be achieved through use of smaller Earth stations. Availability is achievable through site diversity. COMSAT Laboratories will use ACTS to test this theory. Contact: Dr. Asoka Dissanayake, 301/428-4411.

Hopping Beam TDMA Operation Observations

One of the most advanced features of ACTS is the combination of satellite baseband circuit switching, Time Division Multiple Access (TDMA), and spotbeam hopping. This experiment will test the operation of these technologies and will evaluate receive and transmit acquisition performance under normal and worst case operational conditions. Contact: Robert Ridings, 301/428-4264.

Corporate Computer Systems
High Quality Audio (AMT) Experiment
Affiliated Organizations: JPL, CBS Radio

Two mobile satellite communications experiments are planned for ACTS. The first involves interfacing the AMT with a MUSICAM Perceptual Coder and operating this system at coded 64 kbps to demonstrate high quality mono audio transmission. The second experiment interfaces the equipment with the AMT and operates at uncoded 128 kbps. The experiments also involve testing of an algorithm built into the processing capabilities of the MUSICAM Perceptual Coder. The audio coder will monitor the received signal and vary the "amount of coding" necessary to maintain the link. Contact: Dr. Larry Hinderks, 908/946-3800

MITRE Corporation
Protocol Evaluation for Advanced Space Data Interchange

MITRE will study the suitability of standard data communication protocols for future generations of communications satellites. The hopping spotbeam technology of ACTS, together with T-1 VSATs providing direct service to experimenters, suggests that the current method of payload data distribution, using a "bent-pipe" combined with a data distribution hub on the ground (the current Tracking and Data Relay Satellite System method), could be replaced or augmented by direct data distribution to users.

ACTS will be tested and data communication protocols evaluated to determine feasibility of an ACTS-type system for data distribution. Contact: Quoc Nquyen, 703/883-5674.

New Jersey Institute of Technology
Traffic Modeling, Channel Characterization, Coding, and Modulation on the ACTS
Affiliated Organization: Martin Marietta Astrospace

The New Jersey Institute of Technology will perform a group of technology verification experiments. It will test various traffic models for video teleconferencing data. It also will investigate the performance of ACTS at Ka-band and will test several coding and channel equalization methods. Contact: Dr. Y. Bar-Ness, 201/596-3520.

University of Maryland Center for the Commercial Development of Space
Frame Relay Experiments over ACTS: LAN Interconnection Services
Affiliated Organizations: Comsat Labs, National Telecommunications and Information Administration, National Information Technology Center, and University of Colorado

The University of Maryland will demonstrate fast packet switching communication using the ACTS T-1 VSAT network as applied to interconnection of Local Area Networks (LANs). The experiment will measure the bit error rate and performance of congestion control algorithms and confirm ACTS Frame Relay conformance to performance requirements. It will also demonstrate the capability of satellites such as ACTS to interconnect geographically dispersed LANs. Applications to be tested include file transfer, electronic mail, and interactive visualization (X-Windows) between LANs. Contact: Dr. Anthony Ephremides, 301/405-3641.

NASA Lewis Research Center

On-orbit Spacecraft Dynamics
This experiment will determine the spacecraft position (angular and range) as a function of time with respect to the Master Control Station at the NASA Lewis Research Center. Contact: Dr. Roberto Acosta, 216/433-6640.

Mini Terminal Test Bed (MTTB)
The goal of this experiment is to develop and test a communications technology testbed. The testbed will contain state-of-the-art Ka-band subsystems and

components currently being designed by the NASA Lewis Research Center, Space Electronics Division. The experiment will determine the performance of these components for possible use in future communications systems. Contact: Gene Fujikawa, 216/433-3495.

Multibeam Antenna Performance Verification

This experiment will determine the ACTS on-orbit antenna performance and will validate the LeRC Structural/Thermal/RF Analysis Program. Contact: Dr. Roberto Acosta, 216-433/6640.

Networking Technical Experiment for BBP Operations

Performance of the ACTS network control system and the adaptive rain fade compensation technique will be evaluated. Contact: Thom Coney, 216/433-2652.

Microwave Switch Matrix and Wideband Transponder Performance Evaluation

LeRC will verify the ACTS Microwave Switch Matrix (MSM) mode of operation through all of ACTS transponder paths. In addition, the experiment will verify that the MSM can support reliable high data rate communications. Also, various rain fade compensation algorithms will be developed and implemented to explore improved approaches. Contact: Don Hilderman, 216/433-3538.

Communications Link Performance

This experiment will measure co-frequency interference, adjacent frequency interference, adjacent burst interference, and uplink bit error rate performance under various conditions. It will also evaluate ground station performance and investigate clock accuracy on network performance. Contact: Dr. Jon Freeman, 216/433-3380.

ACTS Propagation Studies

The ACTS Rain Attenuation Prediction Model will be tested to verify fade occurrence and duration predictions at ACTS ground stations. The experiment also will demonstrate the capability of rain fade compensation algorithms for the NASA Ground Station in Cleveland. Contact: Dr. Roberto Acosta, 216/433-6640.

Autotrack Control Performance

This experiment will test and verify the on-orbit antenna pointing stability at peak thermal cycles. Contact: Dr. Roberto Acosta, 216/433-6640.

HBR SMSK Interference Experiment (INTEX)

LeRC will measure the bit error rate of a transmitted serial minimum shift-keyed modulated satellite signal in the presence of various types of interfering signals. Contact: Robert Kerczewski, 216/433-3434.

Compressed Digital Video Transmission

Satellite delivery of compressed digital video will be tested. The experiment also will demonstrate the effects of the ACTS system on a 25-30 Mbps broadcast quality digital television system while evaluating video compression hardware over a real channel. Contact: Wayne Whyte, 216/433-3482.

ACTS PROPAGATION EXPERIMENTS

ACTS provides an opportunity to study the characteristics of impairments to Earth-space communications at Ka-band (30/20 GHz) caused by propagation phenomena and to develop techniques to counter them. Rain is a major impediment to Ka-band communications because it causes fades in the satellite signal. It presents quite a challenge to system designers because it causes more severe fades at this frequency than in other, lower frequency bands.

Other phenomena also affect the satellite signal. Clouds and atmospheric gases -- such as water vapor and oxygen -- can also cause signal fades. Tropospheric scintillation (twinkling in the atmosphere) is another important factor. Also, the advent of smaller user terminals with their smaller operating margins increases the need for propagation data.

The ACTS Propagation Program will determine the impairments to the satellite signal caused by the various physical phenomena during the planned experiment period. The experiments will:

* provide a lasting base of 30/20 GHz propagation data for communications satellite builders,
* collect propagation data for a minimum of 2 years, and
* obtain information on the physical processes that cause signal impairments.

Researchers in this field believe that it is necessary to conduct measurements over longer periods of time to obtain valid information concerning the effects of propagation phenomena on satellite signals. ACTS provides a unique opportunity to measure the effects at Ka-band for a statistically adequate time period and in different climatic areas for which no measurements currently exist.

Lewis Research Center issued a NASA Research Announcement to solicit experiments to expand the current base of knowledge concerning propagation effects on Ka-band satellite signals. NASA sponsored the development and production of the ACTS Propagation Terminal for experimenters to use to conduct these measurements. The selected experiments consist of two defined classes.

CLASS I In situ measurements using the propagation terminal to obtain radio wave propagation data at 20 and 28 GHz using beacons on ACTS as the signal source. Propagation terminals will be located in various climate zones in North America to gather this data.

EXPERIMENTS

Colorado State University
Ka-band Propagation Studies Using ACTS Propagation Terminal and the CSU-CHILL Multiparameter, Doppler Radar
Contact: V. N. Bringi, 303/491-5595.

University of Alaska
ACTS Propagation Measurements in Alaska
Contact: Dr. Charles E. Mayer, 907/474-6091.

COMSAT Laboratories
ACTS Uplink Transmit Power Control Measurement Experiment
Ka-band Propagation Measurements Experiment Using the ACTS Spacecraft
Contact: Dr. Asoka W. Dissanayake, 301/428-4411.

Stanford Telecommunications
A Proposal for ACTS Propagation Experiments
Contact: Dr. Louis J. Ippolito, 703/438-8069.
Affiliated Organizations: New Mexico State University, NASA HQ Code O

University of Oklahoma
Rain Attenuation Statistics for the ACTS Propagation Experiments for Central Oklahoma
Contact: Prof. Robert E. Crane, 405/325-4419.

University of British Columbia
ACTS Ka-band Propagation Measurements in a West Coast Maritime Climate
Contact: Dr. M.M.Z. Kharadly, 604/822-2816.

University of South Florida and Florida Atlantic University
Propagation Measurements Using ACTS
Contact: Dr. Rudolph E. Henning (USF), 813/974-4782 or Dr. Henry Helmken (FAU), 407/367-3452.

CLASS II Measurements using either the ACTS communications channels or beacon signals to investigate other aspects of radio wave propagation on new communication services, such as multipath and blockage effects on mobile communications.

EXPERIMENTS

COMSAT Laboratories
ACTS Wide Area Diversity Experiment
Contact: Dr. Asoka Dissanayake, 301/428-4411.

John Hopkins University and University of Texas
Land-Mobile Satellite Measurements in Central Maryland and Alaska Using ACTS: Passive Antenna Tracking System and Mobile Receiver System
Contact: Dr. Julius Goldhirsh (JHU), 301/953-5042 or Wolfgard J. Vogel (UT), 512/471-8608.

Georgia Tech Research Institute
RF Propagation Effects and ACTS Satellite Channel Characterization for Very Small Aperture Terminals
Contact: Daniel Howard, 404/894-3541.

In another effort Teleglobe Canada will be participating in the ACTS Propagation Program, using its own terminal to conduct measurements. The experiment effort is not funded by the NRA, but Teleglobe Canada's data will be included in the overall Program's propagation statistics.

Teleglobe Canada
Measuring Propagation Effects Utilizing ACTS
Contact: Ara Karahisar, 514/868-8322.

ORBITING AND RETRIEVABLE FAR AND EXTREME ULTRAVIOLET SPECTROMETER - SHUTTLE PALLET SATELLITE (ORFEUS-SPAS)

OVERVIEW

The Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer - Shuttle Pallet Satellite (ORFEUS-SPAS) mission is the first in a series of missions using the German built ASTRO-SPAS science satellite. The ASTRO-SPAS program is a joint German/U.S. endeavor, based upon a memorandum of understanding between NASA and the German Space Agency, DARA.

ASTRO-SPAS is a spacecraft designed for launch, deployment and retrieval by the Space Shuttle. Once deployed from the Shuttle by its Remote Manipulation System (RMS), ASTRO-SPAS operates quasi-autonomously for several days in the Shuttle vicinity. After completion of the free flight phase, the satellite is retrieved by the RMS and returned to Earth. The ASTRO-SPAS program is very cost efficient, owing to the versatility and the retrievability of the carrier.

ORFEUS-SPAS is an astrophysics mission, designed to investigate very hot and very cold matter in the universe. The one-meter diameter ORFEUS-Telescope with the Far Ultraviolet (FUV) Spectrograph and the Extreme Ultraviolet (EUV) Spectrograph is the main payload. A secondary, but highly complementary payload is the Interstellar Medium Absorption Profile Spectrograph (IMAPS). In addition to the astronomy payloads, ORFEUS-SPAS carries the Surface Effects Sample Monitor (SESAM) and the Remote IMAX Camera System (RICS).

SCIENTIFIC OBJECTIVES

The ORFEUS-SPAS Mission is dedicated to astronomical observations at very short wavelengths, specifically the two spectral ranges Far Ultraviolet (FUV, 90-125 nm) and Extreme Ultraviolet (EUV, 40-90 nm). This part of the electromagnetic spectrum, which is obscured by the Earth's atmosphere for ground-based observations, bears among the highest density of spectral lines (especially from various states of hydrogen and oxygen), which are emitted or absorbed by matter of very different temperature.

ORFEUS-SPAS will add information to the understanding of the life-cycle of stars by observing some of the coldest (several degrees above absolute zero) and the hottest (more than one million degrees) matter found in our galaxy. Specific mission objectives are:

* Investigation of physical parameters in hot stellar atmospheres
* Investigation of cooling mechanisms of white dwarfs
* Determination of physical parameters of stellar accretion-disks, e.g. mass transfer rates, orbital parameters and velocity
* Shells associated with nova explosions and symbiotic stars
* Investigation of supernova remnants
* Investigation of the interstellar medium and potential star forming regions. In particular, determination of distance, density and temperature
* Studies of the intergalactic medium by observations of quasar spectra

Star formation is not yet completely understood. Stars are, however, known to be formed in dense clouds of interstellar gas and dust. Under gravitational contraction, these clouds can become dense enough to trigger star formation. ORFEUS-SPAS will observe the ultraviolet absorption lines associated with such clouds.

More generally, ORFEUS-SPAS will investigate absorption line spectra of hydrogen and other elements in a wide range of excitation states. Hydrogen is the main constituent of such clouds and can get optically excited by background star light. ORFEUS-SPAS data will allow determination of the size, distance, density and temperature of such clouds, which in turn, aids our understanding of the circumstances under which interstellar clouds collapse and new stars are born.

Once a star is formed, its evolution is mainly ruled by just one parameter, its mass. High mass stars burn energy, through nuclear fusion, more than 100,000 times faster than our sun. These processes give rise to bright ultraviolet emission and strong winds of hot ionized material. ORFEUS will study the surfaces and winds of such objects.

Low-mass stars like Earth's sun burn their energy reserves relatively slowly, not emitting large amounts of ultraviolet radiation. The outermost layers of their atmospheres can become very hot, however, due to turbulent convection which creates shock-waves. ORFEUS will measure ultraviolet spectra of such hot layers of relatively cold stars in order to contribute to an understanding of their physics.

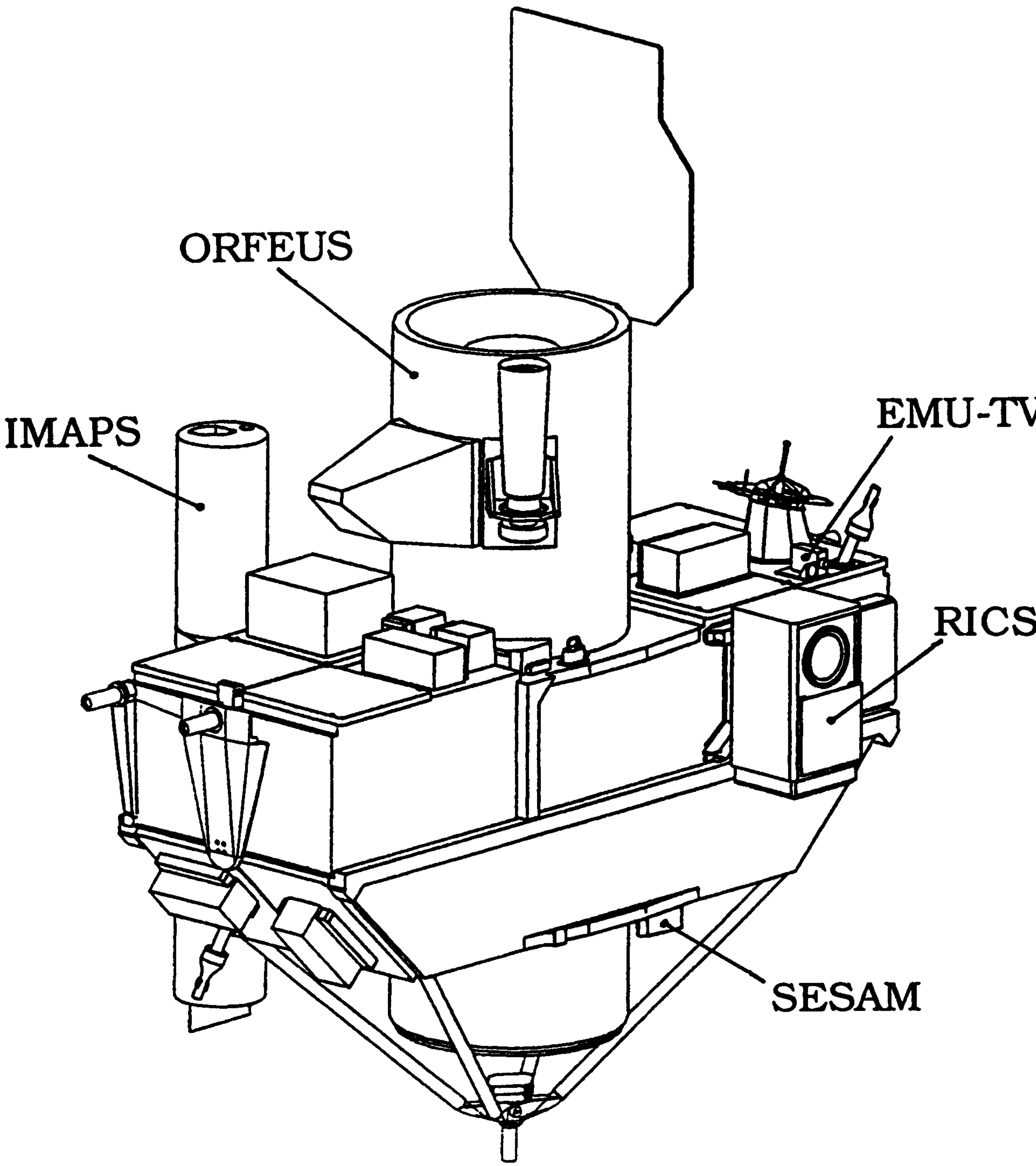
Most stars end up as compact white dwarfs. These stars take a very long time to cool down. During this time, they emit most of their energy in the ultraviolet wavelength range. Moreover, they are among the brightest EUV sources, which makes them perfect targets for ORFEUS-SPAS observations. ORFEUS data will contribute to a new understanding of the cooling mechanisms of white dwarf stars.

Once their energy reserves have been depleted, larger stars explode as supernovae and return their mass back to the interstellar medium. ORFEUS-SPAS is capable of tracing supernova remnants.

Under certain circumstances, the stars of binary systems can exchange material, forming hot accretion disks. ORFEUS observations are aimed at determination of mass exchange rates, orbital parameters and viscosity.

The physics of accretion disks is of particular interest in current astrophysical research, since there is good reason to believe that similar phenomena take place on a much larger scale in the centers of some galaxies, known as Active Galactic Nuclei (AGN). Massive black holes are believed to be surrounded by huge accretion disks. This may even be the case at the center of Earth's galaxy, the Milky Way. Dense dust clouds almost completely prevent direct observation of this region.

AGNs are inherently very bright, but because of the large distance from Earth, even the nearest ones appear very faint. Therefore, only the brightest AGN may be accessible to ORFEUS observations. Because little information is yet available on


ORFEUS
IMAPS
EMU-TV
RICS
SESAM

these exotic objects, even a single spectrum may lead to an important new understanding.

THE SCIENCE PAYLOAD

The ORFEUS-SPAS science payload is provided by German and U.S. research institutions and funded through DARA and NASA.

The core instrument is the ORFEUS telescope with the FUV Echelle spectrometer and the EUV spectrometer, built into the telescope structure. The one meter diameter ultraviolet telescope has a 2.426 m focal length. An iridium coating on the primary mirror serves as a reflection enhancement for ultraviolet wavelengths. Essential stability against mechanical and thermal load deformations is provided by the carbon fibre epoxy compound tube structure.

The EUV spectrometer is directly exposed to light reflected off the main mirror. It covers the spectral range 40-115 nm, offering a resolution of about 5000 over the whole bandwidth. In order to achieve this unprecedentedly high, resolution over such a wide band-width, a completely new design was used. A set of four novel gratings are the key to producing high quality spectra. The groove density of up to 6,000 lines per millimeter is not uniform, but varies over the gratings in a way which compensates for distortions introduced by their unusual location in the telescope beam. Novel detectors, allowing for the resolution of single photon events, can locate the distance between individual photons with a precision of about 30 micro-meter.

The FUV Echelle spectrometer is operated alternatively with the EUV spectrometer, by flipping a mirror into the beam reflected off the primary mirror. The FUV spectrometer covers the wavelength range 90-125 nm and provides a spectral resolution on the order of 10,000. Two reflection gratings disperse the light into a spectrum, which is projected onto a two-dimensional micro channel-plate-detector. The detector is optimized for high spatial resolution.

IMAPS, the Interstellar Medium Absorption Profile Spectrograph is a separate instrument, attached to the ASTRO-SPAS framework. IMAPS was successfully flown on several sounding rocket missions. IMAPS will be operated for about 1 day during the ORFEUS-SPAS mission and during that time will observe the brightest galactic objects. IMAPS operates independently of the ORFEUS telescope. It covers the 95-115 nm band and provides a resolution of about 240,000, which is by far the highest spectral resolution ever achieved by a space telescope. This resolution allows study of fine structure in interstellar gas lines. The individual motions of interstellar gas clouds can be determined to an accuracy of 1.6 km per second.

Another science payload is the Surface Effects Sample Monitor (SESAM), a passive carrier for state of the art optical surfaces and potential future detector materials. SESAM will investigate the impact of the space environment on materials and surfaces in different phases of a Space Shuttle mission, from launch, orbit phase to re-entry into the Earth's atmosphere. Among the SESAM samples are also witness samples to the telescope mirror, allowing for accurate calibration measurements after landing. Sample spaces are available to scientific and industrial users. Since SESAM is very efficient with respect to volume, weight and resources, it is envisaged for future ASTRO-SPAS missions as well.

The Remote IMAX Camera System (RICS) aboard ORFEUS-SPAS will take footage of the Shuttle during deployment and retrieval, to contribute to a motion picture. At the same time, RMS operations and the ORFEUS-SPAS satellite will be filmed by another IMAX camera aboard the shuttle.

The ASTRO-SPAS Carrier

ASTRO-SPAS is designed for up to 10 days of autonomous operation in the Shuttles vicinity, commanded by the mobile German SPAS Payload Operations Center (SPOC). To keep up with the extended mission capability of the Shuttle fleet, increasing the length of the ASTRO-SPAS operational phase is currently under investigation.

ASTRO-SPAS provides standardized equipment support panels, extensive onboard facilities and resources to scientific payloads. Energy is provided by a new powerful Li-SO2 battery pack, which was space qualified for ASTRO-SPAS. Precise attitude-control is achieved by a 3-axis stabilized cold gas system in combination with a star tracker and a specially developed space borne GPS receiver. The versatility of ASTRO-SPAS permits it to support experiments ranging from ultraviolet astronomy to infrared sensing of the Earth's atmosphere. Refurbishment between missions is achieved in less than a year.

SCIENCE PAYLOAD

Instrument	Team Leader	Features
Far Ultraviolet Spectrograph (FUV)	M. Grewing, G. Kraemer Astronomisches Institut Universitaet Tuebingen I. Appenzeller Landessternwarte Heidelberg	Coverage of the 90-125 nm wavelength range; spectral resolution of 10,000; Micro-channel Plate Detector with optimized spatial resolution
Extreme Ultraviolet Spectrograph (EUV)	S. Bowyer, M. Hurwitz University of California Berkeley, Calif.	Coverage of the 40-115 nm wavelength range; spectral resolution of 5,000; detection of individual photons
Interstellar Medium Absorption Profile Spectrograph (IMAPS)	E. Jenkins Princeton University Princeton, N.J.	Coverage of 95-115 nm wavelength range; spectral resolution of about 240,000; sub-Doppler spectroscopy of interstellar gas lines
Surface Effects Sample Monitor (SESAM)	D.-R. Schmitt Deutsche Forschungs-anstalt fuer Luft- und Raumfahrt (DLR) Braunschweig	Carrier for optical samples to investigate degradation of surfaces and materials in space environment; 40 places for user provided samples

KEY SPACECRAFT CHARACTERISTICS

Total Weight	3,154 kg (1,905 kg available to science payload)
Dimensions	4.50 m (payload envelope), 2.50 m (front to rear)
Design Concept	carbon fibre framework, modular equipment support panels support for a 1.2 m telescope
Power System	new modular Li-SO2 battery pack with 10 kwh each, total of 40 kwh available to payload
Attitude Control	3-axis-stabilized cold gas system
Thrusters	12 nozzles of 100 mN thrust each
Attitude Verification	precision star tracker and Global Positioning System (GPS) Receiver
Pointing Accuracy	better than 5 arc seconds
Telemetry/ Telecommand	S-band link to Shuttle, utilizing NASA standard Near Earth Transponder
Data Storage	onboard tape recorder, 60 Gbit
Mission Control	mobile Micro VAX based SPAS Payload Operations Center (SPOC) set up at KSC

Mission Control

ASTRO-SPAS mission control is provided by the SPOC ground station at KSC. The Shuttle is used as a relay station for the command and telemetry link. Real time telemetry data analysis and commanding is provided by the micro-VAX-based ground station. Science data are stored by an onboard tape recorder. Downlink of quick-look data is available.

Future Astro-Spas Missions

The DARA/NASA ASTRO-SPAS program makes provisions for at least three more joint missions. The second mission, named CRISTA-SPAS (Cryogenic Infrared Spectrometers and Telescope for the Atmosphere), will be launched in 1994. A better understanding of the photo-chemistry and small scale dynamics of the Earth's-atmosphere are the main objectives of the CRISTA-SPAS mission.

A reflight of ORFEUS-SPAS is planned as the third ASTRO-SPAS mission. Increased mission duration and possibly improved instrument performance may allow for an extended extra-galactic observation program.

CRISTA-SPAS is planned to be reflown as the fourth ASTRO-SPAS mission. In addition, an Automated Rendezvous and Capture (ARC) mission, utilizing the ASTRO-SPAS carrier, may be flown later this decade as a joint project between the European Space Agency (ESA) and NASA. The ARC mission is designed to demonstrate automated rendezvous and capture technologies in support of the space station.

STS-51 ORFEUS/SPAS RENDEZVOUS OPERATIONS

The ORFEUS/SPAS will be released by Mission Specialist Dan Bursch using Discovery's mechanical arm on the second day of the mission.

While Bursch works with the arm to release the satellite, fellow crew member Jim Newman will oversee the mechanical operations of the ORFEUS instrument and the SPAS. The majority of commands to ORFEUS, however, will come from ground controllers.

Once Bursch has released the satellite, Commander Frank Culbertson will fire Discovery's small steering jets twice to separate from the vicinity of ORFEUS/SPAS, moving at least 13 nautical miles ahead of the satellite.

For ORFEUS/SPAS operations, science ground controllers require at least 1 1/2 hours of communications with ORFEUS/SPAS out of every 4 1/2 hours (three orbits). For these transmissions, Discovery must act as a relay station -- ground communications will reach ORFEUS/SPAS via Discovery and vice versa.

ORFEUS/SPAS will fly free of Discovery for almost 6 days. Discovery will move from being ahead of the satellite to trailing it the day before it is recaptured. The actual maneuvers to recapture the satellite will begin about 5 1/2 hours before ORFEUS/SPAS is captured, with Discovery trailing 30 n.m. behind the satellite. Discovery then will perform an engine firing to begin closing in on to a point 8 n.m. behind the satellite at a rate of about 11 n.m. per orbit. After two orbits and one fine-tuning burn once the ORFEUS/SPAS is in sight of the electronic star trackers on the Shuttle's nose, Discovery will reach the 8 n.m. point.

From 8 n.m., the final rendezvous sequence begins with the Terminal Intercept (TI) burn. The TI burn, occurring less than 2 hours before capture, will send Discovery on a final approach to ORFEUS/SPAS. As Discovery closes in, four mid-course correction firings will be done, if needed, with the Shuttle's small steering jets. The dish-shaped Ku-band antenna on the Shuttle will obtain a radar lock on the satellite.

About 1 hour, 10 minutes before capture, when Discovery is passing about 1 statute mile below ORFEUS/SPAS, Culbertson will take manual control of the rendezvous. Around that time, two laser ranging devices that measure distance and closing rate by bouncing a laser beam off of the satellite, will be used for navigation as well. One laser ranging unit is hand-held and will be pointed by Pilot Bill Readdy through the Shuttle cockpit window at ORFEUS/SPAS. A second laser ranging unit, being flown for the first time, mounted in the cargo bay of Discovery, will be remotely operated. These two units will supplement onboard radar information.

Culbertson will brake Discovery, flying with the control stick on the flight deck as it moves toward ORFEUS/SPAS, finally reaching a point a few hundred feet in front of the satellite. While Discovery is closing in, Bursch will extend the mechanical arm. With Culbertson moving Discovery to within 35 feet of ORFEUS/SPAS and holding position, Bursch will grapple the satellite and reberth it in the cargo bay for the trip back to Earth.

LIMITED DURATION SPACE ENVIRONMENT CANDIDATE MATERIALS EXPOSURE (LDCE)

The primary objective of the Limited Duration Space Environment Candidate Material Exposure (LDCE) is to introduce development composite materials to a flux atomic oxygen atoms in low-Earth orbit. The candidate materials-polymeric, coated polymeric, and light metallic composites will have undergone extensive ground based material performance testing prior to being attached to reusable test fixtures designed for multi-mission Space Shuttle use.

The LDCE, configuration C, consists of two standard 5-cubic-foot GAS cans with Motorized Door Assemblies (MDA's). A crewmember uses the Autonomous Payload Control System to control the payload from the aft flight deck. The LDCE is a simple exposure experiment that utilizes an MDA on each can but does not contain any batteries or fluids.

CHROMOSOMES AND PLANT CELL DIVISION IN SPACE (CHROMEX-4)

Principal investigators:
Dr. Abraham Krikorian, State University of New York at Stony Brook
Dr. Mary Musgrave, Louisiana State University
Dr. Norman Lewis, Washington State University

The upcoming flight of the CHROMEX-4 experiment is the fourth in a series of Life Sciences middeck experiments dealing with the growth of plants in microgravity.

The CHROMEX-4 payload consists of three scientific experiments. They are plant reproduction studies which are a reflight of the CHROMEX-3 experiment; plant cell developmental studies which carry the studies of CHROMEX-1 and CHROMEX-2 to another plant species; and cell wall formation and gene expression studies. The CHROMEX-4 payload also will provide the opportunity to evaluate a new nutrient support system developed at Washington State University.

The anticipated science benefits may lead to new strategies to manipulate and exploit the effect of gravity in plant growth, development, biochemistry and biotechnology. Such understandings will directly benefit the agriculture, horticulture and forestry industries which depend upon plant growth for their products.

The plants being studied on CHROMEX-4 are mouse-ear cress (Arabidopsis thaliana) and a strain of wheat (Triticum aestivum).

Arabidopsis is a small, fast-growing plant widely studied by plant scientists. It is found in the wild and cultivated for research. This plant will self pollinate during the 9-day mission and begin producing seeds. Dr. Musgrave will investigate the effects of the microgravity environment on seed production and seed forming structures of the plants.

Triticum is a superdwarf variety of wheat and has been widely studied among plant researchers. Root and shoot development, cell wall formation and gene expression studies are being conducted on these specimens by Drs. Krikorian and Lewis.

These plant specimens and their nutrient support systems are integrated with the Plant Growth Chambers (PGC) approximately 1 day before launch. The PCGs are loaded into the Plant Growth Unit (PGU). The PGU replaces one standard middeck locker and requires 28 volts of power from the orbiter. This hardware provides lighting, limited temperature control and data acquisition for post-flight analysis. The payload crew is required to perform nominal experiment activities consisting of a daily status check to monitor the PGU's systems' function.

Following the flight of these plants, the investigators will perform complete dissections of the entire plant structure and preserve the tissues by chemical fixation or flash freezing.

The PGU was developed by NASA. The experiment is sponsored by NASA's Office of Life and Microgravity Sciences and Applications.

STS-51 EXTRAVEHICULAR ACTIVITY

STS-51 crewmembers Carl Walz and Jim Newman will perform a 6-hour extravehicular activity (EVA), or spacewalk, on the fifth day of the mission as a continuation of a series of test spacewalks NASA is conducting to increase experience with spacewalks and refine spacewalk training methods.

Walz will be designated extravehicular crew member 1 (EV1) and Newman will be EV2. Pilot Bill Readdy will serve as the intravehicular (IV) crew member inside Discovery, supervising the coordination of spacewalk activities in the Shuttle's cargo bay.

In addition to performing tasks that investigate a spacewalker's mobility in general, Walz and Newman will evaluate several tools that may be used during the servicing of the Hubble Space Telescope (HST) later this year on mission STS-61, including a power socket wrench, a torque wrench, foot restraint, safety tethers and tool holder.

Unlike Shuttle mission STS-57, the astronauts will not use the 50-foot long robot arm during the spacewalk, since it will be important for use several days after the spacewalk to retrieve the ORFEUS-SPAS satellite. Walz and Newman will spend part of their time outside Discovery testing various types of rigid and semi-rigid tethers as well as moving up and down the bay carrying each other, evaluating how well spacewalking astronauts can maneuver in weightlessness with a large object.

Other tests include an evaluation of how well an astronaut must be restrained in weightlessness to apply a large amount of tightening to a bolt using the tools provided. In addition, the spacewalkers will use a large tool onboard Discovery for use in case of a problem with the ACTS/TOS satellite's deployment to evaluate methods of using bulky tools.

As is the rule with the test spacewalks, the STS-51 EVA will be one of the lowest priorities of the flight, subject to cancellation if needed due to a problem with one of the primary payloads. It is planned with a minimum of extra equipment flown on Discovery, making optimum use of materials already aboard for other purposes.

The planned spacewalk will be the third such test spacewalk this year. Previous spacewalk tests were conducted on STS-54 in January and STS-57 in June. NASA plans to continue adding spacewalks to Shuttle flights when they can be performed without interference to the primary activities onboard. The STS-51 spacewalk is the final test EVA planned for 1993. The spacewalks planned for STS-61 in December will be performed to service the HST and not for test purposes.

RADIATION MONITORING EQUIPMENT-III (RME-III)

The Radiation Monitoring Equipment-III (RME-III) measures ionizing radiation exposure to the crew within the orbiter cabin. RME-III measures gamma ray, electron, neutron and proton radiation and calculates in real time exposure in RADS-tissue equivalent. The information is stored in a memory module for post-flight analysis.

The hand-held instrument is stored in a middeck locker during flight except for when the crew activates it and replaces the memory module every two days. RME-III will be activated by the crew as soon as possible after they achieve orbit and it will operate throughout the mission. A crew member will enter the correct mission elapsed time upon activation. ME-III is sponsored by the Department of Defense in cooperation with NASA.

AIR FORCE OPTICAL SITE (AMOS)

This geophysical environmental study will test ground based optical sensors. The experiment will also examine contamination/exhaust plume phenomena using the Space Shuttle as a calibration target.

AURORA PHOTOGRAPHY EXPERIMENT-B (APE-B)

The mission objectives of the Aurora Photography Experiment-B (APE-B) are to photograph the airglow aurora, auroral optical effects, the Shuttle glow phenomenon and thruster emissions in the imaging mode of photography as well as in the Fabry-Perot and spectrometer modes of photography.

COMMERCIAL PROTEIN CRYSTAL GROWTH (CPCG)

The Commercial Protein Crystal Growth (CPCG) payload is designed to conduct experiments which supply information on the scientific methods and commercial potential for growing large high-quality protein crystals in microgravity. The CPCG payload consists of Commercial Refrigerator/Incubator Modules (CR/IM's) and their contents.

There are two possible configurations for this experiment, Block I and Block II. This experiment is configured in Block II configuration for the STS-51 mission, in which the CR/IM contents consist of four cylinder containers of the same diameter but different volumes. The four cylinders are 500 mm, 200 mm, 100 mm and 20 mm. Depending on the specific protein being flown, the temperature is either lowered or raised in up to a five-step process over Flight Day 1 and 2.

One CR/IM occupies the space of one middeck stowage locker. Orbiter 28V dc power is provided to the CPCG CR/IM via single power cables from a standard middeck outlet. The CPCG experiment is installed at the pad within launch minus 24 hours.

HIGH RESOLUTION SHUTTLE GLOW SPECTROSCOPY (HRSGS-A)

The High Resolution Shuttle Glow Spectroscopy-A (HRSGS-A) is an experimental payload designed to obtain high resolution spectra in the visible and near visible wavelength range (4000 angstroms to 8000 angstroms) of the Shuttle surface glow as observed on the orbiter surfaces which face the velocity vector while in low Earth-orbit. The spectral resolution of the spectrograph is 2 angstroms and it is hoped this will help identify the cause of the Shuttle glow. The HRSGS-A will look at the vertical tail, Orbital Maneuvering System Pod or a suitable alternative.

IMAX

The IMAX payload is a 70mm motion picture camera system for filming general orbiter scenes. The system consists of a camera, lenses, rolls of film, two magazines with film, an emergency speed control, a Sony recorder and associated equipment, two photographic lights, supporting hardware in the form of mounting brackets to accommodate the mode of use, two cables and various supplemental equipment.

The IMAX and supporting equipment are stowed in the middeck for in-cabin use. The IMAX uses two film magazines which can be interchanged as part of the operation. Each magazine runs for approximately 3 minutes. When both magazines are consumed, reloading of the magazines from the stowed supply of film is required. Lenses are interchanged based on scene requirements. The IMAX will be installed in the orbiter middeck approximately 7 days prior to launch.

INVESTIGATION INTO POLYMER MEMBRANES PROCESSING (IPMP)

The research objectives of the IPMP is to flash evaporate mixed solvent systems in the absence of convection to control the porosity of a polymer membrane. Two experimental units will be flown. Each unit will consist of two 304L stainless steel sample cylinders connected to each other by a stainless steel packless valve with an aluminum cap. Before launch, the two larger canisters are evacuated and sealed with threaded stainless steel plugs using a Teflon® tape threading compound.

In the smaller units, a thin film polymer membrane is swollen in a solvent compound. The film is rolled up and inserted into the canisters. The small canisters are sealed at ambient pressure (approximately 14.7 psia). The valves are secured with Teflon® tape.

The locker containing the IPMP payload will be installed in the orbiter during the period from L-6 to L-3 days.

STS-51 CREW BIOGRAPHIES

Frank L. Culbertson, Jr., 44, Capt., USN, will command STS-51. Selected as an astronaut in 1984, Culbertson will be making his second space flight and considers Holly Hill, S.C., his hometown.

Culbertson graduated from Holly Hill High School in 1967 and received a bachelor of science in aerospace engineering from the Naval Academy in 1971.

After serving aboard the USS Fox in the Vietnam War, Culbertson was designated a Naval aviator in 1973 and, from 1974-1976, he served as an F-4 Phantom pilot aboard the USS Midway. Subsequently, he was assigned as an exchange pilot with the Air Force, serving as a weapons and tactics instructor at Luke Air Force Base, Ariz., until 1978. His next assignment was as the catapult and arresting gear officer aboard the USS John F. Kennedy. In 1982, he graduated with distinction from the Naval Test Pilot School and, subsequently, served as a test pilot in the Carrier Systems Branch. He was engaged in fleet replacement training in the F-14A Tomcat in 1984 until his selection by NASA.

Culbertson's first shuttle flight was as pilot of STS-38, a Department of Defense-dedicated mission in November 1990. He has logged more than 117 hours in space, more than 4,500 hours flying time in 40 different types of aircraft and 450 carrier landings.

William F. Readdy, 41, will serve as pilot. Selected as an astronaut in 1987, Readdy will be making his second space flight and considers McLean, Va., his hometown.

Readdy graduated from McLean High School in 1970 and received a bachelor of science in aeronautical engineering from the U. S. Naval Academy in 1974.

Readdy was designated a Naval aviator in 1975. From 1976-1980, he served as an A-6 pilot aboard the USS Forrestal. He graduated from the Naval Test Pilot School in 1981. His Navy assignments included the Strike Aircraft Test Directorate, instructor duty at the Naval Test Pilot School and strike operations officer aboard the USS Coral Sea.

In 1986, Readdy accepted a reserve commission from the Navy to join NASA as a research pilot and aerospace engineer at JSC. Prior to his selection as an astronaut, he served as program manager for the Shuttle Carrier Aircraft.

Readdy's first flight was on STS-42, the first flight of the International Microgravity Lab (IML), in January 1992. Readdy has logged more than 193 hours in space and more than 5,500 hours flying time in 50 types of aircraft, including more than 550 carrier landings.

James H. Newman, 36, will be Mission Specialist 1 (MS1). Selected as an astronaut in 1990, Newman will be making his first space flight and considers San Diego, Calif., his hometown.

Newman graduated from La Jolla High School, San Diego, in 1974; received a bachelor of arts in physics from Dartmouth College in 1978; and received a master's and doctorate in physics from Rice University in 1982 and 1984, respectively.

Newman performed post-doctoral work at Rice in atomic and molecular physics and was appointed an adjunct assistant professor in the Department of Space Physics in 1985. He later joined NASA, serving as a simulation supervisor for astronaut training at the time of his selection

Daniel W. Bursch, Commander, USN, will be Mission Specialist 2 (MS2). Selected as an astronaut in January 1990, Bursch will be making his first space flight and considers Vestal, N.Y., his hometown.

Bursch graduated from Vestal Senior High School in 1975; received a bachelor of science in physics from the Naval Academy in 1979; and received a master's in engineering science from the Naval Postgraduate School in 1991.

Bursch was designated a Naval flight officer in 1979 and was assigned to Attack Squadron 34 as a bombardier/navigator in the A-6E Intruder. He graduated from the Naval Test Pilot School in 1984 and later returned to the school as a flight instructor. Later, he was assigned as strike operations officer for Commander, Cruiser Destroyer Group One. He had just completed work at the Naval Postgraduate School at the time of his selection by NASA.

He has logged more than 1,800 flying hours in 35 types of aircraft.

Carl E. Walz, 37, Major, USAF, will be Mission Specialist 3 (MS3). Selected as an astronaut in January 1990, Walz will be making his first space flight and was born in Cleveland.

Walz graduated from Charles F. Bush High School, Lyndhurst, Ohio., in 1973; received a bachelor of science in physics from Kent State University in 1977; and received a master's in solid state physics from John Carroll University in 1979.

Commissioned in the Air Force, from 1979-1982, Walz was assigned as radiochemical project officer with the 1155th Technical Operations Squadron at McClellan Air Force Base, Calif. He graduated as a flight test engineer from the Air Force Test Pilot School in 1983. From 1983-1987, Walz was assigned to the F-16 Combined Test Force, and in 1987 he was assigned as a flight test program manager at Det. 3, Air Force Flight Test Center, where he served at the time of his selection by NASA.

STS-51 MISSION MANAGEMENT

NASA HEADQUARTERS, WASHINGTON, D.C.

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Bryan O'Connor - Deputy Associate Administrator
Tom Utsman - Space Shuttle Program Director
Brewster Shaw - Director, Space Shuttle Operations (JSC)
Loren Shriver - Technical Assistant to the Director of Space Shuttle Operations (KSC)

Office of Advanced Concepts and Technology

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Richard H. Ott - ActingDirector, Space Processing Division
Ana M. Villamil - Acting Deputy Director, Space Processing Division
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Charles Mertz - Acting Deputy Associate Administrator
Richard Perry - Director, Programs Assurance

Office of Life and Microgravity Sciences and Applications

Gary Martin - SAMS Program Manager

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Robert B. Sieck - Launch Director
David King - Discovery Flow Director
J. Robert Lang - Director, Vehicle Engineering
Al J. Parrish - Director of Safety, Reliability and Quality Assurance
John T. Conway - Director, Payload Management and Operations
P. Thomas Breakfield - Director, Shuttle Payload Operations
Joann H. Morgan - Director, Payload Ground Operations
Mike Kinnan - STS-51 Payload Manager

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Dr. George McDonough - Director, Science and Engineering
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Otto Goetz - Manager, Space Shuttle Main Engine Project
Victor Keith Henson - Manager, Redesigned Solid Rocket Motor Project
Cary H. Rutland - Manager, Solid Rocket Booster Project
Parker Counts - Manager, External Tank Project

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Paul J. Weitz - Deputy Director
Daniel Germany - Manager, Orbiter and GFE Projects
David Leestma - Director, Flight Crew Operations
Eugene F. Kranz - Director, Mission Operations
Henry O. Pohl - Director, Engineering
Charles S. Harlan - Director, Safety, Reliability and Quality Assurance

STENNIS SPACE CENTER, BAY ST. LOUIS, MISS.

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Gerald Smith - Deputy Director
J. Harry Guin - Director, Propulsion Test Operations

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James R. Phelps - Chief, Shuttle Support Office.

AMES RESEARCH CENTER, MOUNTAIN VIEW, CALIF.

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Victor L. Peterson - Deputy Director
Dr. Joseph C. Sharp - Director, Space Research

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Thomas E. Huber - Director, Engineering Directorate
Robert Weaver - Chief, Special Payloads Division
David Shrewsberry - Associate Chief, Special Payloads Division

GERMAN SPACE AGENCY (DARA), BONN, GERMANY

Heinz Stoewer - Managing Director Space Utilization
Gernot Hartmann - Head of Space Science Division
Roland Wattenbach - ASTRO-SPAS Program/Project Manager,
Klaus Steinberg - ORFEUS-SPAS Project Manager
Rolf Densing - ASTRO-SPAS System Scientist
Wolfgang Frings - ASTRO-SPAS representative at NASA-JSC
Franz-Peter Spaunhorst - Head of Public Affairs Office
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For Release
June 28, 1993

RELEASE: C-93-i

KSC BASE OPERATIONS CONTRACT EXTENDED FOR 3-MONTH PERIOD

NASA today announced that the Kennedy Space Center (KSC), Fla., Base Operations Contract (BOC), currently held by EG&G Florida, Inc., has been extended for a 3-month period.

The contract extension includes a basic 3-month period priced at $46,543,269 covering the period from July 1 through Sept. 30, 1993, and three additional 1-month options with a total potential value of $44,256,267.

The BOC provides a wide variety of services to KSC, primarily management, operations, maintenance and engineering for KSC facilities and utilities; technical and administrative support operations; and health, fire and security services.

EG&G Florida has held the Base Operations Contract for the past 10 years and is one of four companies involved in a recompetition. The new contract is expected to be awarded in late summer for an initial period of 4 years with three 2-year priced options. The other competitors for the BOC are BAMSI, Inc., of Titusville, Fla.; Lockheed Space Operations Co., Titusville; and Westinghouse Electric Corp., Government Operations Business Unit, Pittsburgh.

- end -

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Washington, D.C. 20546
AC 202 453-8400

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For Release

Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-0873)

June 28, 1993

Mary A. Hardin
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

RELEASE: 93-122

TOPEX POSEIDON MAPS PRECISE GLOBAL SEA LEVEL

During the first 6 months of their mission, scientists using the U.S.-French TOPEX/Poseidon oceanographic satellite have recorded the most accurate measurements to date of global sea level changes.

The data will be used by oceanographers to calibrate the computer models that help forecast future climate changes.

"The changes in sea level we have observed during the first 6 months from October 1992 to March 1993 are a combination of the effects of seasonal warming and cooling as well as wind forcing," said Lee-Lueng Fu, TOPEX/Poseidon Project Scientist at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif.

In the Northern Hemisphere, the sea level in the Gulf Stream off the United States East Coast and the sea level in the Kuroshio regions east of Japan dropped by more than 12 inches (30 centimeters). Most of this drop was caused by the winter cooling of the ocean by the cold continental air mass blown off the North American and Asian continents, Fu said.

In the Southern Hemisphere, a corresponding sea level rise occurred at similar latitudes which resulted from the warming of the summer atmosphere.

"It takes an increase or decrease of 1 degree Celsius (1.8 degrees Fahrenheit) in the average temperature of a water column 50 meters (165 feet) deep to cause the sea level to rise or fall by 1 centimeter (0.4 inches)," Fu explained.

-more-

The sea level change in the Northern Hemisphere is larger than that in the Southern Hemisphere because the larger land mass of the Northern Hemisphere creates colder continental air mass that cools the ocean water off the east coasts of North America and Asia.

Seasonal changes in the trade winds caused a drop in sea level at the equator in both the Pacific and Atlantic oceans, Fu said. The rise in sea level in the eastern tropical Pacific Ocean off the coast of South America was the remnant of the Kelvin wave pulses that began in December 1992. A Kelvin wave pulse creates a surge of warm water that moves eastward along the equator and can contribute to El Nino conditions.

In the Indian Ocean, reversing seasonal monsoon winds caused a fall in sea level in the eastern and southern regions and a rise in sea level in the northwestern region.

JPL manages the NASA portion of the joint U.S.-French mission for NASA's Office of Mission to Planet Earth. Launched Aug. 10, 1992, the satellite is part of NASA's long-term effort to study Earth as a global environmental system.

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EDITORS NOTE: A computer-enhanced image to illustrate this story is available by contacting the Broadcast and Imaging Branch at 202/358-1900. Image numbers are: Color - 93-HC-307
B&W - 93-H-331

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For Release
June 30, 1993

NOTE TO EDITORS: N93-37

STS-51 PREFLIGHT BRIEFINGS SET FOR JULY 6

A series of background briefings for Space Shuttle mission STS-51 will be held July 6 at the Johnson Space Center, Houston, beginning at 10:00 a.m. EDT.

STS-51 will be the 17th flight of the Space Shuttle Discovery. The mission will feature the deployment of the Advanced Communications Technology Satellite (ACTS), as well as the deployment and retrieval of the Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer (ORFEUS) which will be mounted on the Shuttle Pallet Satellite (SPAS).

Following its deployment from the Shuttle, the ACTS-will be placed in a geostationary orbit by a Transfer Orbit Stage (TOS) where it will be used as a space-based testbed for new satellite communications technology. During its week-long free-flight, the ORFEUS/SPAS will gather information on how stars are formed and will study properties of the interstellar medium.

A briefing agenda is attached. All briefings will be carried on NASA Select television with two-way audio for questions from participating NASA locations. NASA Select is carried on GE SATCOM F2R, transponder 13, 72 degrees west longitude.

- more -

STS-51 PREFLIGHT BRIEFING SCHEDULE
NASA Johnson Space Center, Houston, Bldg. 2, Room 135
Tuesday, July 6, 1993

TIME EDT	BRIEFING/BRIEFER(S)
10 a.m.	MISSION OVERVIEW Robert E. Castle, Jr., Lead Flight Director
11 a.m.	ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS)
	ACTS-1 MISSION OVERVIEW AND OPERATIONS Dr. Richard Gedney, Project Manager, Lewis Research Center, Cleveland
	ACTS SCIENCE Mike Smith, Experiments Program Manager, NASA Hqs.
	TRANSFER ORBIT STAGE OPERATIONS Al Hughes, Manager for Upper Stage Projects, Marshall Space Flight Center, Huntsville, Ala.
1:30 p.m.	ORBITING AND RETRIEVABLE FAR AND EXTREME ULTRAVIOLET SPECTROMETER-SHUTTLE PALLET SATELLITE (ORFEUS-SPAS)
	GERMAN SPACE AGENCY'S (DARA) ROLE Dr. G. Hartmann, Head, Space Science Div., German Space Agency
	ORFEUS-SPAS OPERATIONS Dr. Konrad Moritz, Mission Manager, Deutsche Aerospace
	NASA'S ROLE Dr. Robert Stachnik, ORFEUS Program Scientist, NASA Hqs.
	MISSION SCIENCE Prof. Michael Grewing, Principal Investigator University of Tübingen
3:00 p.m.	STS-51 CREW Frank Culbertson, Commander William Readdy, Pilot Daniel Bursch, Mission Specialist James Newman, Mission Specialist Carl Walz, Mission Specialist

- end -